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from E P Mathewson
March 20/34.

PROCEEDINGS
OF THE
ILLINOIS MINING
INSTITUTE

FOUNDED FEBRUARY 1892

1933

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PROCEEDINGS
of the
ILLINOIS MINING INSTITUTE

Founded February, 1892

1933

Summer Meeting
on Board S. S. Cape Girardeau
June 9-10-11

and

Annual Meeting
SPRINGFIELD, ILLINOIS
November 3

Charles F. Hamilton

President, 1933

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Chicago, Ill.

Vice-President
H. A. TREADWELL
Benton, Ill.

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59 East Van Buren Street
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PAST PRESIDENTS OF ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY 1892.

-3 James C. Simpson, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
-4 James C. Simpson, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
-5 Walter Rutledge, State Mine Inspector, Alton, Ill.
} Institute inactive.
-3 John P. Reese, Gen. Supt., Superior Coal Co., Gillespie, Ill.
-4 Thomas Moses, Supt., Bunsen Coal Co., Georgetown, Ill.
-5 J. W. Starks, State Mine Inspector, Georgetown, Ill.
-6 William Burton, V. P., Illinois Miners, Springfield, Ill.
-7 Fred Pfahler, Gen. Supt., Superior Coal Co., Gillespie, Ill.
-8 Patrick Hogan, State Mine Inspector, Carbon, Ill.
-9 William Hall, Miners Examining Board, Springfield, Ill.
-20 William Hall, Miners Examining Board, Springfield, Ill.
-21 Frank F. Tirre, Supt., North Breese Coal & Mining Co., Breese, Ill.
-22 Prof. H. H. Stoek, Mining Dept., University of Illinois.
-23 John G. Millhouse, State Mine Inspector, Litchfield, Ill.
-24 D. D. Wilcox, C. E., Superior Coal Co., Gillespie, Ill.
-25 H. E. Smith, Gen. Supt., Union Fuel Co., Springfield, Ill.
-26 E. G. Lewis, Supt., Chicago-Sandoval Coal Co., Sandoval, Ill.
-27 Wm. E. Kidd, State Mine Inspector, Peoria, Ill.
-28 James S. Anderson, Supt., Madison Coal Corp., Glen Carbon, Ill.
-29 John E. Jones, Safety Engineer, Old Ben Coal Corp., West Frankfort, Ill.
-30 Prof. A. C. Callen, University of Illinois, Urbana, Ill.
-31 Joseph D. Zook, Pres., Illinois Coal Operators' Association, Chicago, Ill.
-32 Geo. C. McFadden, Asst. Vice-Pres., Peabody Coal Co., Chicago, Ill.
-33 Chas. F. Hamilton, Vice-Pres., Pyramid Coal Co., Chicago, Ill.

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ANNUAL MEETING

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Response of President Hamilton to Mayor Kopp
Report of Secretary
Report of the Executive Committee
Report of Auditing Committee
Report of the Membership Committee
Report of the Nominating Committee
The Physical Constitution of Illinois Coal and its Significance in Regard to Utilization, by Gilbert H. Cady
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SUMMER MEETING AND BOAT TRIP

June 10, 1933

Annual Summer Meeting and Boat Trip of the Illinois Mining Institute l on S. S. Cape Girardeau, leaving St. Louis Friday, June 9, 1933, at 10:30 I., and returning to St. Louis Sunday, June 11, 1933, at 8:30 A. M.

MORNING SESSION

eeting called to order at 9:45 I., Saturday, June 10th, by Pres- t Chas. Hamilton.

has. Hamilton: It is indeed a t privilege to greet the members he Illinois Mining Institute and sts on this their 15th boat trip. it is also gratifying to see 93 in party after a year that is prob- unprecedented in many ways; it might have been expected that aller number would have sought such a trip as this.

may not be untimely to say a words on the question of what is g considered in Federal Legisla- in regard to our industry. Soon r the inauguration of President sevelt it became evident that some slation was to be passed regarding . Of course, the Illinois operators e much interested and it was de- d to hold a joint meeting with ana. After two meetings there e five or six fundamental points which the coal men of the two es could agree. Then some ten or ve operators from Illinois and from Indiana had a conference Secretaries Ickes and Perkins Vashington.

s you all know the political con- of the coal industry has always in Southern corporations, and had Washington convinced that ois and Indiana companies had facilities for preparing coal and ld not be considered in the coal ure.

e had a conference on Thursday we stayed until Monday. This an informal meeting at which etary of Interior Ickes and Secretary of Labor Perkins were present and the Industrial Control Bill was discussed. After the Illinois-Indiana draft of the bill was presented, it was gratifying to have Washington say that in the bill there were the most rational points that had been suggested to that time.

Later it was determined that Mr. Buchanan should send out a call for a nation-wide meeting of coal operators in Washington on June 4th. These telegrams were sent to about fifty-six people and the response was very gratifying. When the Eastern and Southern interests were advised of the points in the bill they got busy and tried to block the labor feature. The meeting took place on June 4th and there were about 90 coal men there. It was very adroitly handled by Mr. Buchanan and others from Illinois and Indiana. General Johnson, who is a graduate of West Point, remarked that he was in a very embarrassing position, as he was going to talk on something that did not exist. But that he wanted the coal industry to provide a code of ethics for the other industries to follow. His first points were the question of hours per day, and days per week, and mine wages; also selling prices f. o. b. cars the mine, and the licensing of operators. When the bill was considered by the Senate Committee, these points were incorporated in the bill.

The proposed set-up for this code would be General Johnson and four departments, Accounting, Legal, Industrial and Labor, with a man at the head of each department, and in the coal industry on one side will be an operator and on the other some one connected with mine labor. And of course the heads of all departments will send their reports in to General Johnson.

A committee of 19 was appointed to write the code for the mining industry. It is quite probable that there will be a majority report and a minority report. It is also like that they will not agree with the co tions we should have. But the most encouraging is that Washington rea izes that Illinois is in the co industry.

We will now have the roll call our Secretary.

ATTENDANCE

ILLINOIS MINING INSTITUTE
FIFTEENTH ANNUAL BOAT TRIP

St. Louis to Hannibal, Mo., and return—June 9-10-11, 1933

ADAMS, J. A.	O'Gara Coal Co., Harrisburg,
ADAMS, W. C.	Koppers Rheolaveur Co., Pittsburgh,
ANDERSON, J. C.	United Electric Coal Co., Danville,
ARGUST, W. C.	Peabody Coal Co., Taylorville,
ARMSTRONG, E. R.	Equitable Powder Mfg. Co., Collinsville,
AUSTIN, W. J.	Hercules Powder Co., Chicago,
BARTLETT, A. G.	Burton Explosives, Inc., West Frankfort,
BEALL, C. W.	Beall Bros., Alton,
BENNER, DALE D.	Alcoa Ore Co., Belleville,
BIGGER, I. S.	Vacuum Oil Co., Benton,
BLAKE, ARTHUR	Peabody Coal Co., Marion,
BLANKINSHIP, G. F.	Egyptian Iron Works, Murphysboro,
BREWSTER, BURT B.	Consulting Engineer, Webster Groves,
CADY, GILBERT	State Geological Survey, Urbana,
CARGAL, GORDON	Jeffrey Mfg. Co., Herrin,
CHRISTIANSON, C.	Sullivan Machinery Co., Mt. Vernon,
CLARK, FRED K.	Hulburt Oil & Grease Co., Webster Groves,
CLARKSON, JOHN	Clarkson Coal Co., Nashville,
DAWSON, HUGH	Bethlehem Steel Co, Herrin,
DRINKWATER, JAS. D. S.	Link-Belt Co., Chicago,
DUNN, JAMES	Old Ben Coal Corp., West Frankfort,
ENGLISH, THOMAS	State Mine Inspector, Springfield,
FISHER, STEVE M.	Superior Coal Co., Gillespie,
FLEMING, JACK	Mine Safety Appliance Co., Urbana,
FOSTER, JOHN	Chgo., Wilmington & Franklin, West Frankfort,
GARCIA, JOHN A.	Allen & Garcia Co., Chicago,
GIVEN, IVAN A.,	"Coal Age" New York, N.
GREENE, D. W.	West Virginia Coal Co., O'Fallon,
HAMPTON, I. H.	Beall Brothers, Alton,
HALL, L. W.	Goodman Mfg. Co., Marion,
HALLER, EMIL	Consolidated Coal Co., Mt. Olive,
HAMILTON, CHAS. F.	Binkley Coal Co., Chicago,
HARDY, WM.	Peabody, Coal Co., Taylorville,

RTWELL, LEN	Pyramid Coal Co., Pinckneyville, Ill.
RVEY, HADLEY	Ohio Brass Co., Evansville, Ind.
SKINS, LEE	Bell & Zoller Coal & Mining Co., Zeigler, Ill.
LSON, JIM	Helson Timber Co., Metropolis, Ill.
NTER, THOMAS	Sec'y. U. M. W. of A., Springfield, Ill.
FERIS, J. A.	Illinois Terminal R. R. System, St. Louis, Mo.
INSON, EDWIN H.	Safety Mining Co., Chicago, Ill.
NES, ARCH M.	John A. Roebling's Sons Co., St. Louis, Mo.
NES, JOHN E.	Old Ben Coal Corp., West Frankfort, Ill.
NKINS, S. T.	Goodman Mfg. Co., St. Louis, Mo.
EIN, GEORGE	Klein Armature Works, Centralia, Ill.
OIZEN, A. S.	Joy Mfg. Co., Franklin, Penn.
WRY, R. G.	Roberts & Schaefer Co., Chicago, Ill.
NG, JOS. A.	Jeffrey Mfg. Co., Terre Haute, Ind.
CAS, JOHN	Old Ben Coal Corp., Chicago, Ill.
ONS, JOHN	Bell & Zoller Coal & Mining Co., Zeigler, Ill.
BRY, H. E.	Equitable Powder Mfg. Co., East Alton, Ill.
LSBERGER, A. H.	DuPont Powder Co., Springfield, Ill.
RSH, IAN D.	Alcoa Ore Co., Belleville, Ill.
RSHALL, HARRY	State Mine Inspector, Springfield, Ill.
CLEISH, W. J.	Safety Mining Co., Benton Ill.
YER, BRUNO	Consolidated Coal Co., Staunton, Ill.
YER, CARL	Consolidated Coal Co., Mt. Olive, Ill.
LLER, JAMES B.	Mines Equipment Co., St. Louis, Mo.
LLHOUSE, JOHN G.	Director Mines & Minerals, Springfield, Ill.
ADDEN, NAT	Peabody Coal Co., Taylorville, Ill.
RRIS, NELSON	O'Gara Coal Co., Harrisburg, Ill.
LSON, I. C.	Beall Brothers, Alton, Ill.
YES, J. A.	Sullivan Machinery Co., Chicago, Ill.
LE, J. L.	Hotel Franklin, Benton, Ill.
HLER, F. S.	Superior Coal Co., Chicago, Ill.
HLER, SAM	Superior Coal Co., Gillespie, Ill.
KARD, A. E.	Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill.
VERS, F. A.	Dooley Brothers, Peoria, Ill.
NE, FRANK	Duncan Fdry. & Mchy. Co., Alton, Ill.
SAN, H.	T. E. Joiner & Co., Chicago, Ill.
HART, FRED W.	General Electric Co., Carterville, Ill.
NDOE, C. J.	West Virginia Coal Co., St. Louis, Mo.
IONTHAL, B. E.	West Virginia Rail Co., Chicago, Ill.
IULL, B. H.	Binkley Mining Co., Clinton, Ind.
IULL, F. M.	Binkley Mining Co., Clinton, Ind.
TH, C. M.	University of Illinois, Urbana, Ill.
IMIDT, W. E.	Superior Coal Co., Gillespie, Ill.
RKS, J. W.	Peabody Coal Co., Taylorville, Ill.
IGER, A. E.	Pyramid Coal Co., Pinckneyville, Ill.
DELIN, JOHN W.	Marion County Coal Co., Centralia, Ill.
NTON, W. S.	Vacuum Oil Co., University City, Mo.
OR, DON M.	Sullivan Machinery Co., St. Louis, Mo.
RS, JACOB	Western Powder Mfg. Co., Peoria, Ill.
YLOR, H. H. Jr.	Franklin County Coal Co., Chicago, Ill.

TOBIN, HOWARD	Coal Stripping Co., Pinckneyville, I
THIES, HENRY	Portable Lamp & Equipt. Co., Pittsburgh, P
THOMAS, JEFFERSON	Western Powder Mfg. Co., Peoria, I
TIRRE, F. F.	Better Business Bureau, St. Louis, M
TREADWELL, H. A.	C. W. & F. Coal Co., Benton, I
VLASAK, JOSEPH	St. Louis & O'Fallon Coal Co., East St. Louis,
WATERMAN, C. W.	McNally-Pittsburg Mfg. Corp., Chicago, I
WILKEY, FRED S.	Sec., Ill. Coal Oper. Ass'n., Chicago, I
WILSON, J. C.	Ohio Brass Co., Mansfield, Oh
YOUNG, W. P.	Crescent Mining Co., Peoria, I

Chas. Hamilton: There have been removed from our roll during the past year, Joseph Viano who passed away at Coal City, December 12, 1932, and John Rollo, who passed away February 6, 1933. Let us all stand for one minute as a tribute to their memory.

It has been the thought that we would try to get our business out of the way at this morning session. We have two announcements which I will ask the Secretary to read.

(Secretary Schonthal read invitations from Springfield and Mt. Vernon that the fall meeting of the Illinois Mining Institute be held in their cities).

Thos. Hunter: I make the motion that the next meeting be held in Springfield, Illinois.

Fred Pfahler: I suggest that Mr. Hunter withdraw his motion, and I make the motion that the Executive Board decide where the Fall meeting be held.

John Garcia: I suggest that the members be allowed to voice their opinions.

Thos. Hunter: I would like for the meeting to come to Springfield and if the Executive Board decides to do so, I am sure we will all be glad to have all the members in Springfield.

Pickard: We would like to have you come down to Mt. Vernon, if you can see your way clear to do so.

Millhouse: I believe it has alwa been the policy of the Illinois Mini Institute to distribute the meetin as much as possible. It was on two years ago that we had the mee ing in Springfield, and I feel should visit around quite a bit. have been led to believe that if went to Southern Illinois, a very su cessful meeting could be held ther I have thought that Benton would an ideal place to hold the meetin I believe it would be an honor a a compliment to the next incomi President to hold the meeting there

Harry Treadwell: I know that t fellows from down at our end of t State would appreciate it if the me ing was held there. Also the m down there would sacrifice that pri lege for the benefit of the Iistitu However, I think the naming of t location should be given careful co sideration by the Executive Co mittee.

(Mr. Pfahler's motion as to t Executive Board deciding the F Meeting place was seconded and ca ried unanimously).

Chas. Hamilton: It is now privilege to turn the meeting ov to W. C. Argust.

W. C. Argust: The first thing the program is a paper on accide prevention by Mr. Lyons, Safety E gineer for The Bell & Zoller Coal Mining Company. We will now glad to have Mr. Lyons present paper.

EFFECTIVE ACCIDENT PREVENTION

By JOHN LYONS

Safety Engineer, Bell & Zoller Coal & Mining Company

Zeigler, Illinois

s most of you know, our company
ates two large mines at Zeigler;
at Centralia, and two at Peoria.
le I have visited all of our prop-
s, my work is largely confined to
Zeigler mines, and it is the ex-
ence of these two mines that I
r to mostly in this paper. How-
, our safety and accident pre-
ion work has been standardized
ur Vice President, Mr. Paul Weir,
applies to all of our mines in
ral.

r many years, these mines, like
y others were interested in big
age and if accidents did occur
were just a part of the daily
ine and apparently could not be
ented. Too often in the occur-
of these accidents, it was passed
s a mistake on the part of the
red man and very little was
ght about what the boss or com-
could have done to prevent the
lent or to prevent a repetition
similar accident. It was believed
to put "Safety" first would cut
production. This attitude was
cted from the higher officials
own to the foreman.

cords of production and cost of
were kept, but no records of ac-
ts were kept with the exception
ose required for State and com-
ation purposes. Under this at-
here, serious and fatal accidents
very frequent especially at our
1 mine. From 1920 to 1930 in-
ve, this mine did not operate a
e year without a fatality. As
tter of fact the average number
talities per year for that period
3.27. The tonnage per fatality
was 310,355 and in our worst year of 1929, we produced only 181,046 tons per fatality. During this year this mine was partially mechanized, and the mechanical loading was generally given the credit for the many accidents of that year. As a matter of fact 50 per cent of these accidents occurred in hand loading sections.

Our Zeigler No. 2 mine during the same eleven year period, produced 1,329,943 tons per fatality, and between August 7, 1928 and September 27, 1931, hoisted 3,756,525 tons without a fatality. In recognition of this the mine was awarded the Joseph A. Holmes Safety Association Certificate.

It is singular that two mines, operated by the same company in the same seam and locality should have such a wide difference in their accident records. However, although No. 2 came through so well without fatalities, lost-time accidents were frequent and plans were made to reduce the number of accidents.

Mr. Alex Miller, Associate Mining Engineer of the U. S. Bureau of Mines, visited our properties during the latter part of 1929 at the invitation of our Vice-President, Mr. Weir, and spent several weeks with us, going through the mines, coming in contact with the management and the miners. It was his opinion that the management did not have the right attitude towards Safety and that the management must be sold on Safety before we could sell it to the men. Mr. Weir became thoroughly sold on Safety First principles and he conducted frequent meetings with our foremen and made it plain that the first consideration must be Safety and that they would be held responsible for accidents to men under their charge, and would be discharged if accidents occurred through their neglect. He also laid down plans for an accident prevention campaign. These talks were followed up by many personal letters to all foremen and other officials on the subject.

In January, 1929, a complete record was started which would show the cause of each accident, part of body injured, the occupation of the injured, number of days lost on account of the accident, and under what boss he was working at the time of the accident. Detailed reports were made on each serious accident. From these reports we have been able to determine unsafe practices and conditions which were responsible for accidents and knowing these we have, where possible, endeavored to remove the causes. We have also adopted a standard system used by the U. S. Bureau of Mines and the National Safety Council whereby the "Frequency Rate" on lost time accidents can be computed; that is, it will show just how many lost time accidents occur during every million man-hours worked. Also the "Severity Rate" which shows just how many days are lost due to accidents for every 1,000 man-hours worked. In this system standard charges are used to designate the severity of an accident. For example—6,000 days are charged against the mine at which a fatal or total disability accident occurs, and other standard number of days for less severe accidents.

In this system, it is possible to compare our own mines with others throughout the States using this system, and it readily shows whether we are making progress or falling back

Records are also kept on each fore
man which show the number of man
shifts worked, number of accidents
number of days lost due to accident
on his section each month, and hi
rating. In connection with these rat
ings, we gave monthly prizes to thos
having the best safety record. Late
this was made into a yearly priz
We also placed our mines on a com
petitive basis with each other, mone
prizes going to each boss working
the mine having the highest ratin
This year, we have reduced the for
men's prizes some and plan to giv
to each employee who goes throug
the year of 1933 without losing or
day on account of injury, a souven
pocket knife. We have an annu
Safety Banquet at which the for
men's prizes are awarded by o
higher officials. Safety talks a
given and plans given out for t
next year's campaign. A set of rul
made up by a committee of boss
govern the prizes mentioned.

In selling Safety to our men
used the 100 per cent First Aid trai
ing classes as a basis under the sup
vision of Federal and State teache
We explained to the men the co
pany's attitude on Safety and d
cussed accident prevention. Ta
on this were also made by our Sta
Inspectors. In these classes we h
excellent response from the men.

Having laid the basis for the ca
paign, the next thing was to keep
going and keep everybody Saf
minded. Among the helps to this
we used a system of Safety edu
tion through our Safety Bulle
Board, using posters which w
specially drawn for us, showing s
practices and describing in pictu
safety rules, and showing how
juries had occurred at our own min
We also use a lot of the Natio
Safety Council Posters through

mine, pasting them on concrete
s or piers where strong lights
v them up. We also paste them
he wash houses and on pit cars,
ging them frequently, thus at
ost every turn men are reminded
afety.

'e conducted mining classes for
years covering the mine examiner
mine manager courses. For two
s during the month of December,
ave conducted campaigns for a
Accident Month" each of which,
ough not a perfect month, showed
ded improvement over other
ths of the year and had a lasting
ct on months that followed. Dur-
these campaigns we erected an
ric Safety Calendar which had
ht socket for every day in the
th. At the end of the day, if
ad a lost-time accident. we put
Red light. For no accidents, we
ed a blue light. This created so
h interest that we have used it
since. It is just another idea of
ing the Safety thought before
ybody.

'e publish monthly, a small maga-
called the "Safetygram" in
h we print under the head of,
v it Happened" a description of
lost-time accidents that occurred
ur mines during the month, also
bosses' monthly safety rating. A
of this book is given to all of
men.

uring the last year we have in-
uced the Safety Toe Shoes which
ell at cost, also Safety Hats which
sell at half-price to the men, the
erence being absorbed by our
pany. To the men in our shops
supply goggles free. At our No.
ine, 20 per cent of the men are
ring the hats, and about 35 per
the Safety Toe Shoes. It should
nderstood that the wearing of
hats and shoes are perfectly voluntary on the men's part.

We operate our own Rescue Station, being equipped with six sets of "Gibbs" two hour breathing apparatus. Teams are trained regularly in the use of these apparatus and rescue procedure.

We rock dust throughout the mine entries and use rock dust barriers for the isolation of each pair of panel entries. All our returns are checked for methane content by the use of a U. C. C. methane indicator. Measurement of the quantities of air passing from each return is made at the same time. We endeavor to keep the methane content from exceeding one-half of one per cent in any split as recommended by the U. S. Bureau of Mines. We very seldom exceed this standard. Monthly reports covering these tests and air measurements are made to the Vice-President, General Superintendent, Superintendent and Mine Manager.

As Safety Engineer, I am employed full time in safety work. I make monthly and yearly accident reports, also make special reports on all serious accidents. After such accidents a special investigation is made to determine the cause and place the responsibility for the accident. All persons who witnessed the accident as well as the injured man, if possible, are interviewed. The scene of all data pertaining to the accident is collected. If the accident is attributed to neglect or carelessness of the foreman, he is penalized. This report is made to the Vice-President, General Superintendent and Mine Manager. and is a very important factor in the work of accident prevention. Through these reports the management is advised of the results of our Safety work at all times. When accumulated over a period of years, accident reports show just what causes our injuries and before we can reduce injuries we must know the causes.

Considerable time is spent inspecting roadways for unsafe conditions due to roof and track, etc.; working places for lack of timbering, unsafe practices such as working under top, working between car and face, props set too close to tracks. We have a definite rule that props shall not be set nearer to the rail than 30 inches. Reports of dangerous or unsafe practices found are made to the General Superintendent, Superintendent and Mine Manager. This is another important phase in accident prevention work. If the recommendations of the Safety department are not sustained by the "big boss" the work of the Safety Engineer amounts to nothing. If the management sustains him he must then see that his own recommendations are carried out and enforced by the foreman and should report violations to the management. This work can be done in such a manner that the foreman instead of considering the Safety Man as a detective, always trying to get him in bad, is really looking for dangerous practices and conditions and that his attentions drawn to same will help him to keep accidents from occurring. In this line of work we are getting fairly good cooperation. and one of the main reasons for this is that the Safety department does get the backing of the higher officials, and the foremen know it.

I quote here some of the Safety Standard or Rules we have adopted. Some were adopted through accidents having occurred, others because they presented potential hazard.

1. All track switches should be equipped with bridle bars.
2. All track switches of 60 lb. steel or over, or any switch where it is necessary for the motor to make a drop with his trip, should be provided with double bridl bars.
3. Switch throws should be place on all switches other than roo switches.
4. The ground around switch throw should be kept clear of gob, etc for a distance of at least 15 fe each way.
5. At all places where man-tri load or unload throughout th mine, the trolley wire shall b properly guarded to prevent me coming in contact with same.
6. Trolley wire feeder jumpers th cross overhead from one side the track to the other, if not a ready insulated, shall be proper insulated to prevent any perso coming in contact with live wir regardless of height.
7. Live trolley wires or cable whether insulated or bare, whic pass through wood brattices door frames, must be insulate from the wood by using porc lain insulators.
8. Where men are cleaning up fal on entries with live wire aroun car that is being loaded, th trolley wire should temporari be guarded to prevent conta with same, by being covered wi old fire hose or other suitab insulating cover.
9. Drillers should not be allowed drill places while cutting m chines are undercutting same.
10. No cars shall be switched in a room while such room is bei undercut or drilled, except whe there is a switch inside of roo that can be lined and blocked that runaway cars cannot r into place where men are cuttin or drilling.
11. No person other than motorm and triprider, handling man-tr shall ride the motor of such ma trip.

Lights shall be placed on all main haulage entries at such distances that the rails may be seen at all times between one light and the next.

Where top coal has fallen on main haulage entries exposing slate roof, the same shall be cross-barred.

Hand grab bars shall be placed on the ends of all pit cars for the tripriders.

15. Axe handles used underground should be cut to 20 inches in length.

Sufficient argument for the adoption of Rules 5 and 8 may be found in our State Coal Mine Reports from 1920 to 1930. The report shows that 30 men lost their lives through coming in contact with the trolley wire in Illinois mines.

The following statistics show at a glance that the accident prevention work has been effective:

ar	Z Mine No.	Fatals	Lost time acci-dents	Days lost	Ton-nage for year	Tons per lost time acc't.	Man hours wkd.	Lost time Freq. rate	Sev. rate
29 30	1	8	430	52,552	1,448,364	3,368	1,264,136	240.15	43.74
1	1	3	240	20,562	940,483	3,919	947,288	253.98	21.80
2	1	0	113	1,577	936,785	8,290	975,648	115.82	1.61
9	1	0	71	1,089	698,870	9,843	738,448	96.15	1.47
30	2	0	275	8,710	1,329,483	4,834	1,366,160	201.29	6.37
1	2	0	202	2,078	959,246	4,749	1,147,568	175.99	1.81
32	2	1	94	7,621	859,849	9,147	1,075,272	87.42	7.87
	2	[illegible]	98	3,956	716,790	7,314	1,007,224	97.29	3.92

Our last fatality at Mine No. 1 oc-
rred December 5, 1930. Since that
e we have produced 1,912,834
s, compared with our former aver-
of 310,355 tons per fatality over
eleven year period quoted. In rec-
ition of this improvement we have
t received the Joseph A. Holmes
ety Association Certificate. Our
t fatality at No. 2 was September
1931, and to May 31, 1933, we
e produced 1,336,352 tons.

We are not able to show results
a dollars and cents basis, because
ing the period covered in this
er, we carried compensation in-
ance. It is fair to assume that due
the reduction in fatal accidents
ne at our No. 1 mine, and exclud-
savings through the reduction of
-fatal accidents, we have pre-
ted 6.5 fatal accidents since De-
ber 5, 1930 to date, On the aver-
cost of fatality of $4,150. The
ings due to this decrease in fatal-
s alone would be $26,975.00.

he reduction of accidents attained by this company proves what can be done when definite effort is expended in the right direction for Safety. We do not believe that our system is perfect, but believe better results can be obtained and we are striving for this always.

W. C. Argust: Gentlemen, this is a splendid paper and we want plenty of discussion on it. We expect to call on a number of you to discuss this question.

John Millhouse: I know we have had a very interesting paper read to us on accident prevention. Mr. Lyons has brought out two points that all of us should take into consideration, and that have some food for thought for those who try to prevent accidents.

I know from my own experience from mining men and mines, and unless you show them that they are going to profit by working safely, you are not going to have much success in preventing accidents. The average miner has it in his mind that this accident prevention is just another way of trying to save the company money.

I have in my mind one particular case that came to my attention. This is where prizes were offered to the men that could shoot the best grade of coal with the least powder. That is one way of blocking accidents.

Another instance was the Union Colliery Company policy whereby there were rewards in a money way for men that would get by over a certain length of time without any lost time accident.

But even in the best regulated mines, we have accidents. We had a splendid example of this at Moweaqua, Illinois a short time ago. It was a mine that was never thought to contain gas, but was thought to be safe.

I want to tell you men that we must have something more than an idea to offer; we must offer them some return to get them interested in accident prevention. I have seen and heard a lot of men talk on accident prevention, and I regret to say that we have a lot of companies that are not sold on the idea, but we do have a lot of companies that are.

John Garcia: Mr. Lyons, I am interested in that idea of grab bars on the pit cars. Do you have them?

Lyons: Yes, we have grab bars on all our pit cars. It gives the trip riders a chance to hold on.

J. E. Jones: The paper was very interesting indeed. I have had the privilege of being in some of the meetings of the Bell & Zoller company.

I am very much interested in Mr. Millhouse's talk concerning the shooting of coal. I believe that a great deal can be done in safety by a proper placing of shots. You men do not need to be reminded that in a 5,000 ton mine you must shoot down 5,000 tons of coal in two or three hours. The man who prepares those shots does not fire them. So, two or three times as much powder is used as is necessary.

We have a commission to improve the mining laws in Illinois, and statistics show that the State of Illinois has the best mining conditions of any state east of the Mississippi, and yet our fatality rate is as great as the worst state we have. These fatality rates are in view of the fact that we only take 60% of our coal, while Pennsylvania, West Virginia and Kentucky take 90 to 100% of the coal. So we are attempting to have legislation passed so as to shoot that coal as it should be shot, one shot at a time, and for the person that prepares that shot to also shoot that shot.

Fred Pfahler: I enjoyed the pape to a considerable extent. I wa much interested in one particula point of the paper; the fact tha when they first made a canvass fo going into accident work, was tha the management was not sold on th safety work. The first thing we di when we went into this work was t sell the management.

Mr. Millhouse knows that we mad some records to be proud of.

I note the Bell & Zoller man quote giving prizes for the men making a good safety record. I am no in favor with this plan. We have s far stuck to giving medals for goo safety records. I believe that th success of safety work lies entirely i the management selling themselve to the men.

Frank Schull: Mr. Millhouse possibly was a little bit over-enthuse over what we did in the shooting a Panama. It was a fertile field t make a change in.

I appreciate the paper that wa read here very much, but I figur

t the least explosives used, the
er it is.

Our screenings at Panama were
ry high. I took it up with the
mpany to put out a little prize.
ey agreed and we started the big
ve, the first prize to go to the
n mining the most tons of coal
r pound of powder used. We got
r face bosses interested and event-
lly reduced our screenings to
.2%. The men became very much
thused over trying to show better
sults for the prize money.

We later did this same thing on
r accidents. We were working on
e same system as the paper just
ad describes. When we first
rted, at one of our meetings a man
t up and said that it was impossible
bat 1,000, but it was not long un-
that same man was batting 1,000.

I really think that if a face boss
a section has his men properly
ld on the idea, the men are not
inking of it being sold to them.

We are really geting some place,
t I can just get credit for laying
t the plans, and must give the men
d the face bosses credit for carry-
them out.

James Dunn: I would like to know
en you cut your screenings to
.2% did the miners change their
stem of drilling? Also did they
ub the coal more than they had
fore?

Frank Schull: We did three things
reduce our screenings to this
ure: first we changed our system
drilling; second we hand snubbed;
d third we cut down on our
wder.

James Dunn: I don't know as I
ve much to say. As Mr. Lyons
a neighbor of ours, I have been in
ry close touch with his work. I
ve read Mr. Lyons' safety report
every month, and have always found it interesting.

However, I am a little bit the same as Mr. Pfahler, as to commercializing on safety first. I belong to the "Old School", and I can't quite get it into my head as to why we should pay a man for doing his duty.

We have watched other companies, and we do not wish to criticize them, either for the payment of prizes for safety or for shooting coal. I may change my mind some day about paying face bosses and mine managers for their safety work.

H. A. Treadwell: For the past five years we have carried a report, by the month, and the record of each foreman, and have classified the accidents as to causes, etc.

There was one thing in Mr. Lyons' paper that interested me very much, and that was in their getting about 30% of their men to wear hard-boiled safety hats. We are not going into this because we do not know how to go about it.

In mechanical mining we have increased our foot accidents a lot. I think that the safety-toed shoe is a big thing in mechanical mining.

Lee Haskins: I am like Mr. Pfahler in regard to selling the management on safety. When we started into this work our management was not sold. The first thing we did was to start selling these boys on safety.

Mr. Lyons is a fellow that eats, sleeps and lives Safety First. We started in to sell our boys, and it was not very long until we got results.

In answer to Mr. Treadwell's statement that they do not know how to start to sell the men the hard boiled hats. I do not know of any way of making a man wear safety hat and shoes. We started out by having the bosses wear these hats and shoes. And they demonstrated the use of these hats and shoes, and we are increasing the sale of these all the time.

H. A. Treadwell: How do you handle the sale of these hats and shoes?

Lee Haskins: We carry these in stock. We sell the shoes at cost but sell the hats at a loss.

Mr. Lyons: We carry about four dozen pairs of shoes in stock, and about three dozen hats. The hats cost us $1.50 each and we sell them for 75 cents each.

C. J. Sandoe: This has been discussed a great deal, but there is one question I would like to ask Mr. Lyons. Do you notice any difference in places that are self-insured and those that are insured in some company?

Mr. Lyons: Where a company is carrying its own insurance, I believe a safety program would pay much better. But where you have your insurance carried by some other company, no doubt an effective safety program would lead to some credit on your insurance rates.

H. H. Taylor: We always carried our own insurance up until some time in 1930, and we all felt that there would be a general let down in safety when we changed. But our record after we bought our insurance was better than it was when we carried our own. Now we are back carrying our own, and our record is much better.

Garcia: I want to pay my respects to Mr. Lyons and the Bell & Zoller Coal Company for the Bulletin they put out on accidents, and their description of how the accident happened. I am sure we all learn something from this.

W. C. Argust: I am sure that we could go on for some time with this discussion, but owing to the fact that we have another paper to read, we must continue with the program.

I am sure we all enjoyed Mr. Lyons' paper, and I am sure that all the operators are interested in cutting down their accidents.

The next paper we have this morning is by Mr. John Lucas.

TODAY'S TREND IN THE UTILIZATION OF COAL

By JOHN LUCAS

Combustion Engineer, Old Ben Coal Corp.

The present day trend in the burning of coal is undergoing rapid changes due to influences largely outside the coal industry itself. While these changes are universal in scope, this paper will deal only with those conditions which affect the natural market of Illinois coals, and although a host of conditions have had important bearing on the welfare of the Illinois coal industry, this thesis will confine its discussion to those conditions which have taken place in the art of using coal.

Up to a few years ago, Illinois coal had little serious competition in the steam market from outside fields, and competitive fuels were practically unknown. In Chicago the steam plants were almost entirely equipped with chain grate stokers, using Illinois screenings, and the skillfully prepared lump, egg and nut from our own mines was a popular domestic fuel. The many well prepared sizes produced enabled Illinois coals to dominate a wide market and gain a reputation which is one of their greatest assets today.

During recent years, constant and rapid changes in the utilization of coal has taken place in all types of nts from central station units down varm air furnaces. Some of these nges are favorable to the Illinois l industry and some are not. Var- s sizes of coal have had to be de- ped and new and rigid standards preparation have had to be in- urated.

hree important changes which e seriously affected the market Illinois coals are:

) Introduction of new types of fuel burning equipment.

) The passing and enforcement of new and more stringent smoke ordinances.

) Competitive fuels.

eyond question the change in fuel ning equipment has resulted in ing a pound of coal do consider- y more work than formerly. The rage overall efficiency of boiler ts is at least ten per cent higher n it was ten years ago. Further- e, prime movers have become e efficient which also makes a nd of coal go farther. A central ion of today will make a kilowatt r on half the coal required for a ion of the vintage of 1920. Rail- ds will average twice as many miles on a given amount of coal they were able to ten or fifteen rs ago. It is claimed that during period about twice as much ton- e has been lost to increased effi- cy than to competitive fuels. Al- ugh this loss has been felt, the cient use of our products is highly rable as it prevents greater in- ds by other types of fuel and ps King Coal on his throne.

he practical commercial limits of ciency in the transformation of l into power are being rapidly ap- ached at the present time. The central station units are ex- nely close to their theoretical t. Railroads cannot possibly decrease their coal consumption per ton mile except with tremendous expenditures.

In order to clarify this paper we will roughly group plants into three divisions; namely:

(1) Industrial—Define the industrial plant as one having boilers of 200 horse power or over.

(2) Semi-industrial—This class of plants can be accepted as having boilers rated at from 50 to 200 horse power.

(3) Domestic—The domestic heating plant consists of boilers and furnaces rated lower than 50 horse power.

The power plant fuel burning equipment is being manufactured, sold and installed by large organizations with capable men in all departments.

As a result of extensive research and observation such equipment is being improved in every respect, and the service departments maintained by these organizations are becoming more valuable to the power plants every day.

Automatic controls for regulating the drafts and coal feeds are rapidly becoming standard equipment.

Instruments for indicating and recording what actually takes place in the boiler room are considered a necessity in the industrial plants, partly because such knowledge results in more efficient operation and partly because the data obtained furnishes an accurate basis for cost determinations.

The trend in the boiler room itself is toward fewer and larger units. Instead of a long row of small boilers working at low pressure we now see a few large ones operating at high rating and producing high pressure superheated steam. Auxiliaries, such as bleeder heaters, superheaters, air preheaters and steaming economizers are becoming the rule instead of the exception. Improved methods of handling fuel and refuse are gaining ground, and at the present time practically all units above 500 H. P. have some form of coal handling equipment. The smaller plants are using screw and bucket conveyors and the larger plants are putting in belt conveyors for handling fuel and hydraulic systems for removing refuse.

There is a general change in industrial plants from side feed stokers and natural draft chain grate stokers using small nut coal and the larger size screenings to underfeed stokers suitable for using two inch, one inch and a half, and three-quarter inch screenings, to force draft chain grate stokers suitable for using three-quarter inch screenings and to pulverized coal burners capable of efficiently burning all small sizes of coal, including carbon. We can see that the trend in the power plant demand for coal is changing from small nut and larger sized screenings to smaller sized screenings and carbon.

The semi-industrial plants are changing from handfired shaking grates to underfeed, overfeed, and forced draft chain grate stokers, As handfired plants, they used egg, nut, and two inch screenings. After changing to stokers, they burn one and one-half inch stoker special and two inch, one and one-half inch, and three quarter inch screenings. According to my personal views, a special one and one-half inch screening which contained about ten per cent duff would prove satisfactory for a greater number of installations in the semi-industrial class than any other size of coal.

Domestic heating plants are steadily changing from handfired grates using prepared sizes to underfeed stokers using screenings, stoker special and pea. The last named size is especially suitable for the smallest type stokers using less than fifty pounds per hour. Washed carbon has also been used successfully on these small stokers. At the present time, baby coal burning equipment suitable for one and two family homes are receiving considerable attention of successful designers and manufacturers of power plant equipment. These machines are miniature reproductions of nearly every type found in the industrial and semi-industrial plants, including the screw type underfeed, ram type underfeed, overfeed, force draft chain grate, and pulverized coal burners.

In studying the change in plants and the natural displacement of coal sizes, we again note that the demand for larger sizes is decreasing, whereas, the demand for smaller sizes is becoming greater.

The pea coal, displaced in the change from chain grate stokers in the industrial plants can be absorbed by the domestic stoker. The demand for pea and stoker special coal in the semi-industrial and domestic stoker is growing daily. Increased demand in these sizes necessitates the production of more carbon. We must depend on the powdered coal burner, which is becoming more popular every day, to create a sufficient demand for this size that it will command a fair price. Formerly, the high installation costs and the explosion hazard made the pulverized coal plant prohibitive except for very large units. Today, however, this equipment can be installed for practically the same cost as a modern underfeed stoker and all operation hazard has been eliminated.

The average engineer thinks of powdered coal for boilers larger than five hundred horse power. Some

l known engineers consider that,
he present time, pulverized fuel
allations are economical under
ers as small as two hundred horse
er, and I know of satisfactory
allations of such equipment under
hundred and fifty horse power
ers.

moke ordinances have been
sed and enforced which guided
s of Illinois coal to eastern coal.
customers were definitely or-
ed to burn low volatile coal, in-
l stokers or shut down their
its. Naturally, the domestic
its and a goodly part of the semi-
istrial plants went to New River
Pocahontas mine run. Here we
e a condition where smoke ordi-
ces were stringent and smokeless
expensive; therefore, it is only
ural that a wave of small stokers
ild develop. Although there are
have been for some time, well
gned stokers under the control
properly trained men who insist
good installation, for the most
stokers of a size suitable for
ers smaller than 100 H. P. were
signed with kodaks" by men with-
even the slightest knowledge of
basic principles of combustion.
sequently, stokers which were
with the stipulation that they
ld burn anything black were
ed to use low-ash, high-fusion-
t Eastern Kentucky screenings
to poor inherent design, unwise
ication, and improper installa-
. Some of the legitimate stoker
nizations should be highly praised
the fight they have made to give
public economic heat by putting
tokers suitable for using coals
their respective districts.

am completely in favor of eco-
ic stoker fired units, and wish
ight the legitimate stoker man's
t enemy — the one who dis-
ages the plant owner by selling him stokers with such features as rear end dead plates, narrow side dead plates and insufficient combustion space. Such equipment will struggle along for a while with midwestern coals and in the end will have to use low ash coal from the eastern fields. If at any time in the future the wage scale in the eastern fields approximates that of our own, such plants will be dead horses on the hands of their owners and will have to be replaced by better machines. The coal men are justified and are more or less getting behind the stoker organizations who are capable of giving the plant owner a good job.

Competitive fuels in general have had one effect on the Illinois coal industry. They have caused it to keep on the alert in order to give the customer satisfaction as the introduction of oil and gas burners have set up new standards in heating service. We have studied the new fuel burning equipment coming into our territories and have prepared sizes of coal suitable for their use. We have assisted the industrial plants in obtaining fuel satisfaction by working in the boiler room and have aided the home owner by producing firing charts in the interest of economy and service for handfired units. The Illinois operators have, at the present time, a wide reputation throughout the Middle West as having the greatest selection of sizes, the best preparation, and the most reliable customer service of all bituminous coal fields. In order to maintain this valuable asset, we must understand the problem of the plant operator.

If I were to choose one of the most important sizes of our product to improve, I would suggest a more nearly standardized one and one-half inch screening practically constant in the ratio of constituent sizes and ash content. You, gentlemen, know the factors involved in preparing such a product much better than myself; therefore, I will make no statements as to the practicability of such standardization. However, I know that if we could deliver one and one-half inch screenings conforming close enough to a set standard, that the variation could not be detected by the fireman's eye, a great many less complaints would be made and, consequently, less business turnover experienced.

Let any member of this conference imagine himself as being the fireman in a plant consisting of two 300 H. P. boilers set over dump plate underfeed stokers. He would be selling his services for a wage and would be chiefly interested in doing as little work as possible and in holding his job. If a car of coal comes in containing an excessive amount of bug dust in even a part of the car, he will have to burn a product containing a large amount of ash and a different ratio of sizes. In burning these fines he will have to handle more coal, poke the fires oftener, break up clinkers, remove more refuse and probably be called on the carpet for allowing the evaporation per pound of coal to diminish. In all probability he would tell the chief engineer that the coal was no good. Then when the purchasing agent asked the engineer how the coal was running he would answer, "Not very good, the last car was nearly all dust which caused the fireman more work, lowered the overall efficiency and increased our maintenance costs by causing more fly ash, incrustation of boiler tubes, deterioration of walls and burning of stoker tuyeres." After a number of such reports the purchasing agent would in all probability try a car of coal from another source. We must also bear in min that most complaints are made, no because the coal is really giving trouble, but because **the last car** wa not as uniform as the previous one Any change in the ratio of sizes o component parts can be detected b the fireman in many ways. Suc changes necessitate more careful attention, give less efficient results an cause general dissatisfaction whic results in the loss of customers. Occasional cars of coal consisting o large percentages of nut sizes ar received and plant operators ar prone to use such cars as a standar by which to compare all shipments Naturally, when such a car is immediately followed by a car containin an excessive amount of fines, th result is not good. Undoubtedly a improvement in the preparation o screenings looking toward a mor nearly uniform product is worthy o very great effort.

The general shift in the deman for coal is from the larger sizes t smaller ones. Screenings are n longer a by-product and are becoming more important as a basic product with every installation of modern firing equipment. The trend i definitely toward bringing the pric of all sizes to a mine run basis wher all tonnage may be sold at a profi

The increased efficiency experienced during the past twenty year cannot be duplicated in all time t come and we will never again witnes the rapid loss in coal consumptio due to higher efficiency as seen during the past decade. Consequentl the total demand for fuel must sho a substantial increase more or le in proportion to the increase in demand for power and heat. The demand for the last named commodities has steadily increased and ca be expected to continue doing so fo many years to come.

ne marked trend toward high e scales and better prices in the ern fields gives us hopes of being to regain a portion of our lost ket by increasing the price dif- ntial in our favor. Our strong constant fight against competi- fuels in general has prepared us reclaiming such tonnage by con- ally strengthening the coopera- spirit between the production rtment and the sales department ur respective organizations. Let trive to give our customers the product on the market.

N. Smith: I have enjoyed Mr. as' paper very much. I have e a complete analysis of the d to make greater use of the ler sizes of coal. The fact that trend is moving forward at a d rate is very encouraging.

B. Miller: For the last three or years we have made a small unit will burn any of the small sizes oal. We have a small unit at the e that we have just developed is used for heating water. This aintained on a coal consumption 4 pounds in 24 hours. The unit ery inexpensive and requires only HP to operate. We have had opportunity to compare this with and we found we could heat water with coal, using one of e units, from 1/2 to 1/3 of what could do it for with gas.

. C. Argust: Are there any rs who would like to discuss the zation of coal?

fferis: There is not a coal sales- on this boat. The salesmen go out to sell these smaller sizes oal for the stokers are basing prices on the cost to the big s. I think we should have this r read when there are some salesmen on board.

am not in favor of having so sizes of coal. I can see no need of it. I do think we should have some means of getting the producers of the coal and the salesmen together. There should be some connection so that there would be a better understanding.

This paper is all right, but who is going to follow it up? I think we should have the coal salesmen come on this boat.

H. H. Taylor, Jr.: I think this paper was very timely. We talk a different language from the salesmen. I think it is very necessary to have a paper of this kind. We are interested just generally in the utilization of fuel, but this paper will help us to prepare fuel. Therefore, I say again that the paper was very timely.

E. H. Johnson: A few years ago I visited a plant in the East to see an operation that used small coal. I was only just mildly interested in this, but I was very much interested in what it was doing at some of the properties. They were producing a low ash coal, and naturally they would expect to have many clinkers, but by treating that coal with dedusting machines, they were taking out this fine stuff and throwing it away. Now that is along the line of what Mr. Lucas meant and it is very likely.

H. A. Treadwell: I had an experience last winter that I want to tell you, just to show you what rotten salesmen coal men are. I was at a place where there was a circuit judge, a lawyer, a superintendent of a factory, a general manager and myself. Everyone of those fellows had oil burners in his home. I was the only coal man there. I got to talking to those fellows about stokers, and there was not one of the bunch that knew anything about an automatic stoker.

The coal dealer, instead of buying a good grade of stoker coal, generally buys the cheapest grade. If we are going to get into this stuff, we are going to have to sell these men real coal.

Lucas: I want to agree with the last speaker. Practically every stoker man sells his stoker to burn the cheapest coal that it is possible to buy. The biggest fact is that stoker men are now working on a stoker to successfully burn the smaller sizes of coal.

Chas. Hamilton: I want to express the thanks of the Institute to Mr. Argust for the fine manner in which he has handled the meeting thi morning. We will now stand adjourned until this afternoon.

AFTERNOON SESSION

Chas. Hamilton: With a great dea of pleasure, I am turning this afternoon session over to Mr. Harr Treadwell.

H. A. Treadwell: Gentlemen, thi afternoon I think we have some ver interesting papers, and we can mak the meeting more interesting by al of us entering into discussions. I a sure it will be of benefit to all.

COMPETITIVE FUELS

By B. R. GEBHART

Director of Public Relations, Illinois Coal Bureau
Chicago

At the Illinois Mining Institute Meeting, on Board the Cape Girardeau, Saturday, June 10, 1933.

Last month, as a result of suggestions made by several of our operating executives here in Illinois, I had the honor to be invited to give a paper on competitive fuels before the American Mining Congress at Pittsburgh. I don't know whether my sponsors wanted to get me out here on a boat so they could take a closer shot at what I said, or whether they really liked the paper. At any rate they asked if the same information might not be presented before the Illinois Mining Institute and I appreciate very much this opportunity to get before our own operating people a brief picture of the battle going on in the energy market of this country.

Your understanding and appreciation of the competitive fuel problem is important for several reasons. Chief among these is the desperate need for collaboration between production and combustion engineers t the end that Illinois coal may b given an improved form value whic will adapt it more readily to successful use in newer and better coal burning equipment. The success of coa competition with oil and gas depend first upon its being made availabl at the lowest possible cost, an second, in such form that it can b utilized not only at a high degre of efficiency but with convenienc and satisfaction. This problem cannot be separated as between the min and the market. The old notion about producing cleanly graded coa according to the standards of th past, and even some of the standard of the present, loading it into ca and kissing it good-bye at the min must be dismissed if coal is to hol its place in the sun.

Let us look briefly at the energ picture. Back in 1913, King Co justified his majestic title by developing 84.3 per cent of the total annual energy supply of the Unite

es derived from mineral fuels
water power. Since that time
throne has been unsteady. In
0, coal's percentage was 77.2, and
931, the last year for which fig-
are available, the percentage
dropped to 56.5. Of this amount,
racite coal was responsible for
per cent and bituminous coal 48.6
cent.

uring these years petroleum and
ral gas combined jumped from
per cent in 1913 to 18.5 per cent
920, and to 35 per cent in 1931.
percentage of energy developed
water power has increased in
ut the same proportion, from 3.3
cent in 1913 to 4.3 per cent in
0, and to 8.5 per cent in 1931.
authority for these figures is
U. S. Bureau of Mines. A tabula-
showing percentages as well as
ntities in trillions of B.t.u.'s is
ched as an appendix to this pa-

seems necessary to have in mind
general picture of the changing
tionship between the fuel sources
nergy the country over, in order
conditions in our central western
itory may be fully understood.
competition of fuel oil with coal
he Central West has been severe.
example, in our state of Illinois,
state having larger resources in
verable coal than any other state
of the Missouri River, over 20
cent of the owned homes are
pped with oil burners, and conse-
ntly are heated with fuel oil.
percentage is four times the na-
al average and is higher than that
any other state. Conservatively,
s estimated that substitution of
oil for coal in its natural market
itory during the last ten years has
the Illinois coal industry more
ten million tons in annual pro-
ion.

atural gas, relatively a new competitor in the Middle West, is charged with displacing during 1932, probably five million tons of coal from various sources. Last summer in a survey conducted by salesmen of Southern Illinois coal producing companies, it was found that in 59 cities located in the states of Illinois, Iowa, Minnesota, Missouri, Nebraska and South Dakota, natural gas had replaced coal in industrial plants to the extent of 4,622,250 tons annually. This takes no account of the displacement for domestic use, which is rather difficult to compile. It was further determined that in 185 towns in these same states, natural gas competition was either actual or impending, threatening the replacement of over four million additional tons of industrial coal now shipped to these towns annually from the Southern Illinois field alone.

If you were to plot a chart showing the production of energy in the United States as converted to B. t. u.'s, according to the various sources, coal, oil and gas, and water power, you would discover that the coal curve rises steadily until about 1918, when it started to break, and it has gradually descended ever since. In contrast, the curves for both oil and gas, and water power, have steadily risen to the present date, oil and gas most rapidly during the last fifteen years. As another mental picture, consider a chart showing the ratio of energy produced by coal as compared to oil and gas at ten year intervals. Prior to 1900 coal held the overwhelming majority, but in 1929, gas and oil had risen to more than half the total of coal, while we have seen from the figures already cited that in 1931 the relationship was still more unfavorable insofar as coal is concerned.

Since 1929, thousands of miles of natural gas pipe lines have been built from source areas to industrial centers in the United States. Over 5,000 miles of such pipe lines were laid during 1931 alone. The majority of this mileage directly serves the markets for Illinois coal. A map of the United States in which the total natural gas pipe line mileage constructed to date is superimposed resembles a spider web, so vast is the extent of natural gas distribution.

Most coal producing areas have a problem in the matter of competitive fuels throughout the market areas which they serve, similar to the problem we face in Illinois. Consequently, most coal men, both in the operating and sales departments of the business are familiar enough with the losses coal has sustained to competitive fuels, and with the availability and distribution of these fuels, so that I need not here dwell further upon this side of the picture. Rather than graveyard whistling let us study briefly what has been done and can be done about it.

In the first place, I believe it is necessary to dismiss from our minds any such ideas as that the price of fuel oil is going to go so high as to prohibit its use for domestic heating or industrial purposes, or that oil burners cannot continue to be successful, or that people will not pay the price for burners or for oil. The answer lies in the fact that while we have cherished these ideas, nearly three quarters of a million oil burners have been installed in residences in the United States. Another such idea is that the financial foundation of the gas pipe lines is insecure and liable to crumble, that the cost of gas transmission over long distances is too high to permit general use, that the pipe lines will break or the gas will freeze or explode, or that the price of gas can never get low enough to disturb seriously the industrial coal market.

These notions have already been disproved in figures I have cited. The natural gas pipe lines are with us and it looks very much as though they were going to stay. The notions here described have in the past lulled coal men into a false sense of security and have resulted in a national loss in annual coal production to competitive fuels and water power of something in the neighborhood of 125 millions of tons.

In my opinion, excluding specialized application of fuels, there are only two points at issue as between coal on the one hand and oil and gas on the other. These are cost and convenience. Water power can be excluded for the present because the potential sources of what might be called hydraulic energy are definitely limited. Cost is relatively more important in industrial applications and convenience in domestic applications.

Both cost and convenience are affected by the method of use. It is here that the purveyors of oil and gas have had a ten year jump on the coal man. Bear in mind that oil in the tank and gas in the main are as helpless as coal in the bin unless mechanically efficient and adaptable devices are available for their regulated consumption. During the past ten years extensive researches have developed oil and gas burners and methods for their application to a high degree of excellence. This development has been stimulated largely by oil and gas fuel interests. In contrast, I believe it can be safely stated that the coal man's chief interest has been efficient production of coal at the mine, while he has neglected the application of coal in the hands of the ultimate consumer. As a result, oil and gas interests have been successful in securing higher prices per on B.t.u.'s for their fuel than the people, and yet have made and continuing to make tremendous s in the energy market.

uring recent years we in Illinois been forced to change our atti- and seek methods for protecting markets. Something had to be about the threatened loss of ad- nal millions of tons of industrial ness to natural gas. A brief y indicated that the laid down of coal at plants in our market was composed roughly of one- l coal cost f. o. b. mines, and two- ls freight. After trimming mine es to the limit, appeal was made he railroads to protect their ht revenue by trimming the age charges.

e western carriers petitioned nterstate Commerce Commission elief at certain specified destina- , and after a series of hearings, relief was granted at points e natural gas competition act- existed. With this assistance the railroads, we have cleared of the hurdles in the matter of which is most important in the trial picture.

ntinuing the battle, combustion eers were sent to various tened plants to devise ways and s of improving the method of application, thereby increasing ency and further reducing cost. ist one example, I can cite the Light Plant at Rochester, Minne- where stoker and other plant tments accomplished an increase ual evaporation of 1.25 pounds ound of coal burned, which was alent to a reduction in the de- d coal price of approximately 50 per ton, or a reduction of 40 per cent of the f. o. b. mine

stoker, both in domestic and rial sizes, offers an effective weapon to the coal man. Whether or not the domestic stoker in its present state of development is the last word in automatic coal burning equipment is not to be debated here. Excepting the use of powdered coal, stokers do offer the only tried method of controlled combustion of coal. Such a method is needed to compete with the burners provided for oil and gas.

In the domestic field stokers permit the retail coal merchant to offer a degree of heat service which is somewhat comparable with the fully automatic service provided by gas and oil. Stoker hoppers still have to be filled with fuel and ash receptacles removed, but these services are being prformed for a fee by coal merchants in many citis. Thus equipped with thermostatic regulation, the home owner is freed of all duties in connection with his heating plant and can enjoy the economy of coal with none of the labors hitherto associated with it. Perhaps in the near future we may have a completely automatic domestic stoker for bituminous coal which will fill itself from a main storage hopper and dispose of its own ashes. Some such machines are now on the market for anthracite.

The installation of smaller stokers has increased rather promisingly in the last few years. The Bureau of Mines is authority for the statement that 55 establishments reporting installed roughly 22.000 stoker units during the years 1931 and 1932. The total number of installations recorded at the Bureau up to and including February, 1933 was 33,541. While this by no means represents all installations, it does show some progress in the face of the more than 700,000 oil burners now in operation.

Other examples of recent activities here in our home markets may be of interest to you. Among other things, we have learned that comparisons of coal heating in conventional, I might even say traditional hand-fired coal plants, with heating by oil or gas in these same plants after they have been cleaned up, modernized, the houses or buildings insulated and the burners equipped with thermostats and automatic controls, are very much to the disadvantage of coal. The only fair comparison is between a thoroughly up-to-date mechanically fired coal plant, and oil and gas installations, under similar conditions.

The coal merchants in Chicago, assisted by the coal operators, determined that under equal conditions, heat could be provided with coal at approximately one-half the price of oil, and one-third the price of gas. Rather extensive advertising of these relationships has been carried during the past three years in Chicago newspapers. The results have been illuminating in several ways. For one thing, this almost unique effort of the coal man to tell the public in mass the true story of the advantages and economy of his fuel has been amply rewarded. In spite of the large number of oil burner installations elsewhere in Illinois, the figures now show that since the start of this campaign, there have been less oil-burner installations per capita in Chicago than in any other major city in the United States.

After the advertising had been running for some time, the coal merchants were challenged by a building management concern to prove their advertised statements. A reputable commercial laboratory was employed to make a series of tests at two Chicago hotels which were equipped with oil burners. The oil burner people were invited to adjust their equipment to their satisfaction and the plants were operated for several weeks under service conditions, accurate data being kept by the laboratory staff. The oil in these installations cost 4¾ cents per gallon. At the conclusion of the oil tests, the burners were removed and stokers were installed, on which midwestern coal costing $5.15 per ton, delivered was applied.

At the conclusion of the stoker tests, it was discovered that at one hotel the saving in the total heating cost, all items such as labor and depreciation being included, was 36. per cent in favor of coal, and at the other hotel 43.3 per cent in favor o coal. Needless to say, this building management firm completed th change over to stokers and coal and in three months time reported tha they had actually saved 30 per cen of the total cost of the stoker installations as well as building change necessary to accommodate the handling and storage of coal. I cite thi example to illustrate the result o comparisons between coal burned i modern fashion and competitiv fuels, under equal conditions.

These experiences taught us th necessity for educating the publi as to the true possibilities of coa The Illinois Coal Bureau publishe and distributed widely, a booklet entitled, "Debunking the Fuel Question," which goes into the matte of application and efficiency of di ferent fuels under different circumstancess. I am sorry that time he will not permit fuller discussion o this phase of the subject, but I sha be glad to send a copy of this boo let to anyone interested.

As an illustration of the nature o our conclusions, we plotted the rel tive cost of heat in various fuel based on the average of domest prices in 300 middle western citie the coal as it lies in the bin, the o in the tank and the gas in the mai study bore out the generally ied relationship regarding the of heat in the diferent fuels, ely that with a dollar's worth Illinois coal, twice as much is obtained as with a dollar's h of gas. Introducing the ele- of efficiency, which is governed he type of equipment in which uel is used, it is discovered that hly the same 1-2-3 relationship ns as between the cost of heat ed from stoker coal, fuel oil and ral gas. In this case we applied nbined efficiency of 65 per cent oker fired coal, 65 per cent to oil, and 75 per cent to natural

e booklet also presents several l examples. One compares $5.50 is stoker coal in Chicago with ral gas. This example shows for pure natural gas to produce at equal cost, it would have to be at a retail rate of 26 cents per sand cubic feet, which is about hird of the current cost of mixed or domestic heating purposes in ago.

hope that in the foregoing dis- on I have at least given you an ation of what I mean by the erate need for collaboration be- n our production and combus- engineers. Obviously, the job ducating the public as to the value of coal compared with fuels, is a job for the sales de- nents. But there is a bigger As we have seen, oil and gas continued to grow in popularity in use in spite of the superior omy of coal. The bigger job is of research, both in the prepara- and the use of coal, to the end the public may be provided with type of convenient heat and r service which it demands.

me very exceptional work along line is now being conducted in the laboratories of the State Geological Survey at Urbana and in the Mining Engineering Department at the University of Illinois. However, more immediate results can logically be expected from individual coal companies whose production and combustion men together study the rapidly changing needs of the market and prepare to meet these needs. Such work has been going on for years in the anthracite industry and the results should be a brilliant inspiration to all of us. Cooperatively, through the Anthracite Institute, and individually in their own laboratories, anthracite producing companies have developed and offered to the public vastly improved furnace and stoking devices as well as sizes and preparations of coal, specially and closely fitted to the needs of the devices.

Very recently many new things have been tried in the way of washing, screening and cleaning bituminous coal, particularly the smaller sizes for stoker and other mechanical application. But we have just made a start. It is going to be necessary to follow this thing through as one of the newest and biggest problems facing the Illinois coal industry. Our competing coal fields are alert to the need and are making daily progress in suiting their product more closely to the needs of the market. Whether our studies shall result in packaging coal at the mine, selling it on a guaranteed therm basis with a therm certificate accompanying each car, or whether coal shall eventually be pulverized or gasified at the mine, and transported to market through the pipe lines which we may inherit from the natural gas speculators, remains with you men to settle in collaboration with your combustion engineers. But the problem must be settled.

The laboratory must be called

into partnership with both ends of the coal business if we are to deserve a profit for taking advantage of the rich heritage of coal resources wit which nature has endowed this country.

QUANTITY AND PER CENT OF ANNUAL SUPPLY OF ENERGY IN THE UNITED STATES FROM MINERAL FUELS AND WATER POWER.
Figures from U. S. Bureau of Mines.

	1913		1920		1931	
	Trillions of B.t.u.'s	Per Cent	Trillions of B.t.u.'s	Per Cent	Trillions of B.t.u.'s	Per Cent
Anthracite	2,490	14.0	2,437	10.9	1,619	7.9
Bituminous Coal	12,535	70.3	14,899	66.3	9,906	48.6
Petroleum	1,593	8.9	3,295	14.7	5,385	26.4
Natural Gas	626	3.5	858	3.8	1,760	8.6
Water Power	588	3.3	971	4.3	1,721	8.5
	17,832	100.0	22,460	100.0	20,391	100.0

H. A. Treadwell: I think there are two or three things that stand out to the coal producer. The first and most important to all of us is that 1910 coal produced 85% of the energy produced in this country, and now coal has been reduced until it is only producing 56% of all the energy. This shows an increase of gas, oil and water power from 15% in 1910 to 44% in 1932.

I can remember when we claimed that the operation of oil or gas was dangerous. We must forget this line of argument, and meet this problem with constructive thought. We also used to say, "Just wait until it gets cold and the gas and oil won't be there", but everyone now knows that is not the case.

B. B. Brewster: I have just finished a very intensive study on this subject for a company. They are producing a new designed boiler at this time.

Frank Tirre: I think we should have more discussion on this subject. I do not like to see a subject like this passed up. Down in the St. Louis field we are making a study of this subject.

Lucas: I might give some data that I have obtained from a concern that have changed over seven of thei large generating plants to gas. Thes people are very particular to ge everything there is out of any fue they burn. The highest efficient plan they have out of these seven is running at 74% efficiency on gas. Thes boilers are all large. They figur on these same boilers their coal efficiency would run about 69%.

In burning gas under ordinary coa boilers, you require approximatel 20% more combustion space, and th efficiency of such constructed boiler go down below 50% when gas is use for firing.

I talked with the engineer who ha charge of their operation and kep the records, and he says that it requires a great deal more attentio to burn gas than coal. But any tim you talk to a gas man, he will neve set down less than 75% efficienc for gas, and not more than 65 efficiency for coal.

H. H. Taylor, Jr.: Is it not eas to get 75% efficiency from coal?

Lucas: It is pretty hard, but ther are some plants that are getting 92 efficiency. With powdered coal the are averaging about 85%, hand fire operations about 50% and stoke fired operations about 65%.

OAL CLEANING AS APPLIED TO PREPARATION

By WILLARD C. ADAMS
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he object of preparation is to in-
ase marketability and to stabilize
value of a given coal by produc-
a uniform fuel of physical and
characteristics inherently suited
the consumers' particular use. It
expected to provide a fuel com-
itive in its natural markets with
s, Oil and Coals that are uniform
ash fuels as mined.

he extent and methods of pre-
ation that should be employed are
marily economic problems in which
rket requirements, the consumers'
asure of value and monetary re-
ns to the operator are the con-
lling factors.

he application of preparation
st be adaptable to changes in
rket requirements and conditions
t is always to fulfill its purpose
be a true aid to selling at a
fit.

ncreased net realization cannot
expected on any application of
paration that does not add tan-
e values to the user, or on pre-
ation methods that are not eco-
ical.

t has been definitely determined
sizing is an important factor in
d preparation, as it governs to
rge extent the behavior of a given
when applied to a given use, or
pecific conditions of combustion,
ates of combustion. Where the
is to include two or more primary
s, blending, in certain predeter-
ed proportions suitable for a
n service, is necessary to securing
best performance with a given
.

ccurate separation of coal into grades having small size range is a thoroughly established practice in the Illinois field. Proper methods of separation, which includes types of screens suitable for the upper sizes, and dedusting or aspiration for the very fine sizes, has been definitely determined in that field by experience. In a few instances, mixing facilities are provided whereby a uniformly blended coal of a specific sizing specification as may be best suited to a given use can be furnished.

The full benefit of cleaning in accomplishing the purposes of preparation cannot be secured for steam and domestic markets unless it is considered as an adjunct to sizing, mixing and loading, so that the various preparation facilities can be properly coordinated in design and operation. Without such coordination, there is a possibility that a cleaning system, even though producing the desired results in treated coal and refuse, would be considered a commercial failure on the basis of monetary returns. Quality and suitability is important, but so also are costs of such marketable products.

The removal of the impurities in coal will enhance its value to the extent of monetary savings and benefits that can be effected by reason of:

(1) The elimination of the purchase price, freight and handling cost of useless material.

(2) A uniform fuel with increased heating value and less slagging, resulting in improved boiler efficiency and decreased boiler

maintenance, boiler outage, ash handling, fly ash and sulphur compounds in the flue gases.

(3) The elimination of bone, laminated and other objectional material in sizes that are judged and sold mainly on appearance.

On this basis, it would appear that a premium price for cleaned coal in all sizes could be expected, but while buyers are coming to realize that for practically every use better results can be obtained from coal if free from non-combustible material, it is difficult to arrive at a definite figure for expected increase of realization.

Existing preparation plants have, however, proven:

(1) That a uniform sized and cleaned product increases marketability with a resultant reduction in production costs due to increased running time.

(2) That the mechanical cleaning has permitted the guarantee of quality to within recognized tolerances of sampling and analysis with a resultant decrease of complaints and cost of adjustments.

(3) That mechanical cleaning has in cases made possible greater seam extraction and mining efficiency.

In considering the removal of impurities from the complete range of sizes as mined, hand picking, based upon visual inspection and mechanical cleaning must be considered. The proper scope of each as applied to a given condition, should obviously be determined on the basis of efficiency, costs and coordinization. The mere fact that hand picking is already in use at a given operation, when mechanical cleaning is to be applied, should not alter this procedure.

The cleaning of the sizes larger than 6″ must for the time being be considered as a hand picking job. There is not at this time a commercially proven process available to handle this size.

It is generally advisable to feed the coal to be cleaned unsized, because of lower cost and to avoid excessive degradation that would result from handling, and the double screening necessary when cleaning by sizes.

In general, it has been the practice to limit the top size in mechanical cleaning to 4″ or 4-1/2″. The desirable range of mechanical cleaning, therefore, would be from 4″ or 4-1/2″ down, including all smaller sizes which, if cleaned, will aid to increase the net realization of the operation.

On the basis of direct cleaning cost, it may often seem advisable to include the 6″x4″ with the above sizes to be mechanically cleaned. This may be entirely feasible with some coals, and doubtless a demand for its inclusion for beneficiation with the smaller sizes would bring about the necessary mechanical development in the equipment of the various cleaning processes.

The 6″x2″ sizes of many seams, however, have a light gravity laminated coal, which must be removed to secure a product to pass a rigid visual inspection. This material in the 4″x2″ size can be removed by a higher gravity separation than required for the 6″x4″. In making the necessary separation for the latter there would also be removed as middling some good coal of the 4″x2″ size. This middling material would be crushed and re-treated to maintain recovery, but nevertheless, there would be a monetary loss due to unwarranted breakdown of the 4″x2″ size. This loss could be avoided by hand picking the middlings, but would involve an additional labor cost. To secure practical results on the Illinois No. 6 and similar coals with the 6″x4 included, would, for economy and

er operating advantages, probably
cessitate making 1-1/2″ the lower
e limit, and cleaning the Minus
/2″ sizes in a separate unit.

Equivalent cleaning by hand as
mpared to most mechanical meth-
s for any size below 3″, is imprac-
al, and the attempt to so clean,
cept for small tonnages, can de-
itely be considered as uneconom-
l if cleaning cost and results alone
e considered.

Hand picking in any size results
a reject, which in cases amounts
3% of the total tonnage of which
m 60 to 65% is good, recoverable
al. This is either reprocessed by
nd, and sold, or used on the basis
a very low value, or disposed of as
fuse, and in either case represents
oss chargeable to method of clean-
g.

It is good practice to crush these
kings to free the impurities and
x with the feed to the mechanical
aning unit. The value of the coal
salvaged should be credited to the
eration of mechanical cleaning if
costs of the latter are set up
arately. It would seem, however,
t comparisons in costs should be
de on the basis of total prepara-
n, in which case the salvage value
m pickings would be taken into ac-
nt automatically.

n mechanical cleaning, the prac-
al problem is to make the desired
aration at the predetermined spe-
ic gravity to be simulated in clean-
as complete as possible. There-
e, the most efficient cleaning pro-
s is one that will produce cleaned
l with a minimum of sink (refuse)
l refuse with a minimum of float
mbustible matter). The effici-
y of a cleaning process is also in-
ated by the character of this float
l sink in that the best results are
wn by a high ash float in the
refuse, and a low ash sink in the cleaned coal.

The desirable cleaning process must properly clean all sizes as fed to a uniform marketable quality, whether that quality be judged by ash analysis, or by appearance, and in so doing it shall not permit unnecessary losses, or jeopardize the cleaning of other sizes. It must also lend itself to a plant operation that will be flexible, economical and efficient in preparing, handling and loading the products.

In considering the mechanical cleaning of the Illinois No. 6 and like coals of sizes below 4″, the removal of the laminated material in the 4″x2″ and possibly down to 1-1/2″ will be found very necessary. Examination of the various gravity fractions of these sizes show this material to be of light gravity and it will be necessary, in effect, to operate at a lower gravity down to 1-1/2″ or 2″ than on the smaller sizes.

This is readily accomplished with a process having a separate primary and secondary cleaning. The primary is adjusted to give separation equivalent to the lower gravity necessary for removal of the undesirable laminated material. The heavier gravity material removed would pass to the secondary where separation would be made on the basis of the higher gravity suitable for satisfactory cleaning of the smaller coal. The cleaned product from the secondary would be screened to segregate the plus 1-1/2″ or 2 ″ as desired, and that material crushed and returned for recovery of the good coal it may contain. The undersize is not crushed, and is mixed with the product of the primary cleaning.

It is not sufficient to depend upon the inherent characteristic of a cleaning process that when treating a range of sizes produces the effect of separating the larger sizes at a lower gravity than the small coals. Such a method does not give proper control, and furthermore, in order to obtain recoveries, rock would have to be crushed with the middlings, unless hand picking is used. The deliberate introduction of unnecessary rock into a cleaning system is wrong practice.

Many coals, and among them the No. 6 Illinois seam, have flat, slabby impurities, the removal of which presents a problem, especially, to a process depending upon a vertical force or impulse for classification. When the flat side is exposed to such a force, there is a tendency to change its effective gravity, and the piece is raised from the rock bed and goes over with the coal. Recirculation of a Middlings material reduces the probability that heavy, flat pieces will remain with the good coal. The inherent characteristic of a process and their effect on the removal of such objectionable material should be carefully considered in order that a clean product may be assured.

The shales which form a part of the impurities of the Illinois No. 6 seam, have a tendency to disintegrate and slack in water; therefore, with wet cleaning processes, consideration should be given, not only as to the time these materials remain, but also to what action it is subjected, while in the system. The character of agitation has been proven by tests to have a definite bearing on the amount of degradation within a given time. Under proper conditions, the amount of disintegrated material that enters the washing system is not a handicap to wet washing. It settles out rapidly, and is easily removed, and adequate spraying will remove all trace of it from the washed products.

The coal produced by some mining systems, notably stripping, carries a considerable amount of very fine fire clay. Floatation is the only process that will effectively separate the coals from such clays, in say Minus 100 Mesh. Processes treating an unsized feed depend on aspiration, or washing through a fine mesh screen for the removal of this material. Either method entails the loss of practically all of the minus 50 Mesh Coal. The removal of this fine mesh material generally improves the quality of the product by giving a better size characteristic for most uses in addition to ash elimination.

The general results in efficiency in cleaning by wet and dry processes indicate that a more complete separation can be obtained on all, or any size, by the wet process. The coal product will show less sink, and the refuse less coal loss.

The main advantage of dry cleaning is that it does not add moisture to the products as prepared for market. This added moisture, however need not be detrimental in sizes above 5/16". Efficient screen dewatering can be expected to show the following surface moistures in sizes above 5/16".

4"x2" Moisture 2%
2"x¾" Moisture 2.75%
¾"x5/16" Moisture 3.75%

The problem, therefore, applies more especially to the cleaning of Minus 5/16" coal. Dry cleaning of this size furnishes a dry product, and eliminates the problem of removal and recovery of wet sludge from the washing system. It has on the other hand the problem of removing the dus from the air discharged from th cleaning system and maintaining satisfactory working conditions in th plant.

The dewatering of Minus 5/16 coal from a wet process can be accomplished by several different meth with approximately the following lts:

Dewatering elevator with a resultant moisture of 20%.

A dewatering high speed screen with wedge wire, or cloth mesh having openings of about 50 Mesh, with a product having moisture of 10 to 16%.

A dewatering elevator in combination with a centrifugal dryer giving expected moisture in product of from 5 to 7%.

A dewatering elevator, or screen in combination with heat drying. The moisture in the product would be under control down to a low practical limit of 3%.

choice between two cleaning sys- s is a subject for very careful y and should be based on:

The character of the expected products from the two systems.

The present and possible future requirements as to physical character of marketable coal.

The comparative costs of cleaning.

would seem in general that when coal to be cleaned is plus 5/16″, wet system should be used. A al and economical solution, when coal down to zero or 50 Mesh is e cleaned also, might be the wet m down to 5/16″ in combination a dry process for the sizes below ″.

he amount of makeup water re- ed for a wet process is often con- ed a problem for operations in in localities. It would seem that difficulty is exaggerated by the ght of the streams of water that to be discharged from the wash- lants of years ago. Plants hav- eed with surface moisture about xpected in Illinois Shaft Coals perating with makeup water re- ments of from 14 to 15 gallons per ton of 4″x0 product. A wet coal feed would reduce this by the amount of water brought in by the feed coal as surface moisture.

The value of the reject is a considerable item, and it is general practice in determining cleaning costs to charge this loss on the basis of mine costs. Proper consideration for the coveries will often result in savings as demonstrated by certain plants where the recoveries are considerably higher than indicated in one instance by an actual refuse ash of 70%, as compared with a theoretical of 66%. This is accomplished by freeing of coal from high ash impurities by crushing, and system of handling peculiar to the process.

A feed to a cleaning system that presumably has the fines removed, will still contain an appreciable quantity of under-size material due to normal inefficiencies of screening and degradation. Such of this material as is not recovered after cleaning, either due to inadequate auxiliary equipment, or to an inherent characteristic of a cleaning process that makes its recovery impossible, must be charged as a loss against cleaning.

Mention is made here of some of the features to consider when cleaning the No. 6 Illinois seam, but every coal has its own peculiarities and problems in this respect. The desirable cleaning process is the one that lends itself by reason of its inherent characteristics to the best solution of these problems.

The cost of operation for the various processes is subject to calculation, or based upon such information from going plants. Costs should include, maintenance, labor, power, supplies and cost of reject.

The supply item for a wet process includes water, and the amount of water in circulation has a very considerable bearing on economy of operation. It naturally affects pumping costs, but perhaps more seriously the items of capital investment and operating costs for sludge handling.

The commercial success of any cleaning system is still greatly dependent upon the over-all design of the plant. Only the proper sizing and loading of a cleaned product, and possibly drying of the minus 5/16" coal, if cleaned wet, can assure a fuel which will, for a given coal, furnish in a satisfactory manner the cheapest over-all heat or power unit, which is the fuel the consumer will use.

CLEANING COAL BY THE AIR-FLOW

By R. G. LAWRY
Roberts and Schaefer Co.

Recently there has been a renewal of interest in cleaning coal by air. It has been brought about by problems which arise in washing, especially as applied to fine coal. One of the new developments in air cleaning is called the Stump Air-Flow. It is really an air jig.

The Stump process of air cleaning is comparatively new, the first experimental work having been started about a year and a half ago. Most of the testing work was done at the Bakerton Mine of the Barnes Coal Company. A brief description of the operating plant which resulted from this development work will be given later. It will be interesting, first, to examine the construction and operation of the Air-Flow unit.

This is a sketch of the machine with a normal coal bed. The Air-Flow consists of an air tight box with a pervious deck offering resistance to the passage of air. The air enters at the back under the deck from a blowing fan. The raw coal flows on the deck which is placed on a slight slope. The air pressure is adjusted so that it will lift the coal and form a fluid boiling mass. This action causes a stratification of the particles in the bed according to their specific gravity. The bed flows down the slope due to the air pressure lifting the coal, eliminating the friction. I front the top layer or clean coal flow off on a gravity chute. The lowe and heavier layer of material to b rejected also flows off to a pocke with a hinged gate at the bottom.

The rejection of refuse is not a all in proportion to the thickness o the bed in the deck. This materia moves much slower than the coal du to the friction and weight of the coal To fix the position of the cutoff chut for the coal where it will separate th clean coal from the reject, makes i necessary to maintain the depth o the refuse bed. This is controlled b the refuse gate.

The flow of air through the machine is not constant but is inte rupted by a revolving pulsator whic cuts off the air twice for every revo lution of the valve. This air pulsa tion accomplishes two things, first i raises the bed and allows the heav particles to settle and second, it pe mits the automatic operation of th refuse gate by the dashpot. Th dashpot consists of a tank of wate or non freezing liquid by the side o the machine. There is an air pipe ex tending up the center of the tan with the bottom connected to the a pressure chamber. Over the top o the pipe and in the water is an i rted “can” suspended rigidly by a l from a walking beam.

The air pressure lowers the water the inside, and raises the water the outside, and also raises the per part of the dashpot until there a balance with the refuse gate ich is hung from a rod on the other d of the walking beam. Adjust- nts are made of the rod lengths d also by means of sliding weights the beam. These adjustments per- t the correct opening of the refuse te to control the flow of this ma- ial. The air pressure alone fixes position of the gate but the pump- action due to the pulsator pre- nts blocking at the gate.

The automatic control is produced follows: if the refuse bed thickens e to a slug of high ash feed, the essure is increased due to increased resistance. The higher pressure ses the dashpot and lowers the re- se gate, permitting an increased re- tion until the bed is reduced to rmal again. Likewise, if there is sudden decrease of heavy material the feed, the dashpot will lower d the refuse gate will close until bed is built up again.

All of the Air-Flows now in opera- n are three product machines, mak- a middling product between the an coal and refuse. A cutoff chute placed between the coal chute and deck which leads the middlings a pocket similar to that for the ect. There is also a gate to con- l the flow which is operated from beam in the same manner as the use. In plant design the middle duct can be retreated in case it a mixture of coal and refuse, or en treating coals that produce a e bone or high ash coal, the prod- can be retained for special uses. r some coals where only a low re- tion is possible, it is policy to re- at both refuse and middlings together. I have here cuts and description of the Air-Flow used at the Barnes plant and elsewhere, also the latest Air-Flow box. A recent addition is a reciprocating feeder for the coal, and wire glass sides that enable the operator to see what is taking place at all times and to make rapid adjustments to take care of abnormal conditions. In this unit the slope of the pack is adjustable and it is self contained with the pressure chamber so air leaks are eliminated.

The Air-Flow is designed for cleaning sized coal, the usual size range being about one to three. In treating screenings the smallest size is about 1/4″x0. Of course this size is fixed by practical consideration as screening coal smaller than 1/4″ or 3/16″ is more expensive than is warranted. Very good ash reduction can be accomplished on the above size.

Combined ash reduction and dedusting is easily done on the Air-Flow. In our test plant experiments in cleaning, there has usually been more suction applied than was necessary. Enough work has been done to show that a very efficient removal of dust below 48 mesh can be accomplished, and that the air can be controlled to remove only finer sizes or more coarse material.

I have a drawing showing the Air-Flow cleaner built for the Barnes Coal Company at Bakerton, Pennsylvania. The coal at this mine is the lower Kittanning, commonly called Miller B. The plant handles 360 tons per hour of 3″x0 raw feed.

A flight conveyor brings the coal to the plant and the clean coal is returned to the tipple in another similar conveyor. From the 150 ton surge bin the coal is fed to six Ro-Sieve screens, making the sizes 3x¾″, ¾″x¼″, and ¼″x0. Each is cleaned as follows: The first size in three 18″ Air-Flows; the second size in three 18″ units, and the last size in six 24″ units. The middlings, and if desired the refuse, from the 12 primary units is retreated in five units on the floor below. The clean coal from all the cleaning boxes goes direct to the conveyor returning to the tipple. The final refuse is all delivered to a refuse bin for delivery to the gob pile.

The air supply for several Air-Flows is drawn from a plenum chamber served by a fan. At this plant there is one chamber and fan for the two largest sizes of coal; one for the smallest size, and one for all the recleaning units. A better technical arrangement would be one plenum chamber and fan for each size of coal.

The static pressure varies from three ounces per sq. in. for the 2″ coal to five ounces or less for the ¼″ size. The air volume will vary from 5,000 cu. ft. per min. per 12″ width of the deck for the 2″ coal to 1,500 cu. ft. per min. for the ¼″ size. The air volume is about 250 cu. ft. per min. per ton average for the above range of sizes. At the Barnes plant the dust is collected in two conical collectors. The air volume for this purpose is slightly more than for cleaning but at a pressure of only about 1½ oz.

Coal cleaning for commercial uses usually aims at a definite point of ash reduction with as small a bank loss as possible rather than the maximum possible ash reduction at the sacrifice of recovery. The Air-Flow process is essentially one of retreatment as by this means during the primary treatment the bulk of the low ash coal can be disposed of so tha the retreating units can deal with a feed of high ash material. Thi method gives the best results.

COAL CLEANING METHODS IN ILLINOIS

By J. W. WILSON

McNally Pittsburg Mfg. Corp.

Presented by Mr. C. W. Waterman.

We want to express our appreciation to the Institute for the courteous request of is Program Committee, through the Institute's secretary, Mr. Schonthal, for the presentation of some views on coal cleaning in our State of Illinois. We are also outlining some equipment, admirably fitted for the economical and satisfactory preparation of coal.

In view of the limited time available, a detailed description of coal cleaning practice is hardly possible, but we believe that generally speaking, coal cleaning in Illinois largely centers around a wet washer system. Because of lack of time, the many and varied reasons for much of the present disturbance of the Illinois small, raw coal market will have to b passed over and assumed, as you me are perhaps more familiar with thos reasons than we. However, by wa of pointing to a few major factors we may recognize more fully wh the cleaning of our coal is essentia to the industry's complete recover in this State. First, reducing pric competition by increasing quality second, reducing the ultimate cost t the consumer by lower freight cos per ton and a greater efficiency pe pound of coal burned.

When we look back to the growt of the coal industry in Illinois an to the high place it once occupied i preparation, we can trace that prestige directly to the enterprise of th

ators of the period prior to the
ld War. Up to that time, the
best in preparation was the only
ideration. Naturally, a consider-
part of the preparation of small
was done by coal washing. The
had not been practiced to the
t it has at present, but a renew-
of intent to get back to basic
dards of preparation has brought
turn to more serious considera-
of such facilities. I am sure
if finances were available no
t the entire state would be full
odern mechanical coal cleaning
pment and the small coal shipped,
, would bring back the high
dard of quality together with the
ket, since lost to other field coals.
e decreasing demand for the
er sized coal and the increasing
ket for small coal will make pos-
a wider distribution for a good,
-prepared small coal.

the 10 year period from 1907 to
, the tonnage washed in Illinois
ually increased from about 2½
on tons (out of about 51,000,000
produced) in 1907, to about 4¾
ion tons of washed coal in 1917
of about a total production of
00,000 tons). If 60% of this prod-
is considered as 3″ screenings
, of the 50,000,000 tons of 3″
enings, almost 10% was washed.
e market at that time justified a
ed product, obviously the pres-
efficiency of fuel burning equip-
makes it more essential than
to prepare the present pro-
ion.

ith the ever increasing mechan-
loading devices being used in the
rground mines, it is absolutely
tial to clean such loaded coal.
same general rule applies to all
ped coal.

is paper will discuss briefly only
type of wet cleaning, the Baum
This jig originated in Germany
in 1900. Later in 1903, the system was introduced in Great Britain and today has obtained great preference in the British Isles. There are several manufacturers building Baum type units in England, but to date, only two types of this system are in use in our country, the Simon-Carves and the Norton Automatic. While the different types of Baum jigs vary considerably in some features, the underlying principle of separating is the same in all makes.

In this type of jig, pulsation of the washing bed is effected by air pressure. By arrangement of air inlet and exhaust valves, air pressure is admitted to the off-side water column thus forcing upward current through the washing bed and on the exhaust cycle of the air, the washing bed is allowed to slowly settle. Thus stratification is taking place on both the upward and downward stroke of the pulsation. If the downward stroke is too violent (caused by "back suction"), the stratification process is much hindered and if the back suction is extremely violent, stratification on the downward stroke may be rendered nil and the wash box becomes in effect, an intermittent upward current classifier. There are some authorities who maintain that with the back suction properly controlled, more effective stratification is obtained on the down stroke than on the up stroke of the pulsation. In the light of these opinions, it is fair to presume that with a properly controlled back suction, the stratification on the down impulse may be made as effective as on the upward movement, thus making for maximum efficiency.

The principal advantages of the Baum type over the usual mechanical plunger type jig lies first, in the perfect and easily adjustable control of the pulsation and limitation of back suction to the point of most efficient operation. Second, the larger capacity per unit, it being possible to handle as high as 150 tons per hour or more in a single unit, and the multi-stage washing action made possible by the several washing compartments incorporated in each unit. In the standard two refuse discharge Baum jigs, we accomplish the same result as would be obtained by using two separate units, one operating to remove the very heavy or pure refuse, and the other operating at a lower gravity separation for removing the lighter refuse or middlings.

In many coals there appears in the nut or egg size (5″ to 1″) what are termed middlings. These individual pieces are made up partly of coal and partly of bone or other heavy refuse. With the Baum type washer, recovery of the coal from these middlings is made possible by the two gravity separation in the unit. As stated previously, it is possible to draw off the pure refuse through the primary refuse gate and elevator and the middlings through secondary refuse gat and elevator. The middlings delivere from the secondary refuse elevato may be crushed down to about 1 thus freeing much of the coal fro the refuse and returned to the was unit for retreatment and recovery o the cleaned coal. In some cases, may be desired to load a low grad high ash coal, in which case the mid dlings product may be loaded ou without retreatment.

In first cost, for a given tonnag Baum type units are generally som what higher than the average w process. However, when their highe capacities are taken into considera tion, thus reducing necessary buil ing structure, and with their e tremely low maintenance cost, in th long run, they will wash coal at less cost per ton than the averag competitive wet system. After a the important thing is the considera tion of the amount of coal lost wit the rejects and the amount of refus left in the cleaned coal. The effic ency of the Baum unit in this respe clearly justifies its slightly highe cost.

THE DE-DUSTING OF COAL

By E. M. MYERS

Dorman, Long & Co., Ltd.,
Bowburn, England

Presented by J. D. S. Drinkwater of Link Belt Co., Chicago

It has been known for a considerable time that in the mechanical cleaning of coal either by dry or wet processes, particles below 1/50th inch pass through the plant without being appreciably cleaned, and therefore constitute a handicap to the effective cleaning of the remainder. For this reason the removal of the "fines", or "de-dusting" as it has become known, is now considered a an essential feature of modern coa cleaning plants, and indeed dedust ing apparatus has been fitted int existing plants with very beneficia results.

The first attempts at de-dustin were made by using various types o screens, but even with the driest o coal, such methods were only partiall

ssful, for if the dust contained
a small amount of free mois-
viz: 2% or 3%, the screen aper-
rapidly became choked, thus
sly affecting the screening ef-
cy, while with very damp coals,
nethod became quite impractic-

alternative to screening out the
fine dust was to treat the coal
larger apertures of 1/8th inch
re, which would not become so
choked, but this resulted in a
derable bulk of uncleaned coal
recovered which could not be
xed with the cleaned product, or
readily disposed of as a separate
ct. Furthermore, this fraction
e coal also contained quite a
amount of material that could
been cleaned in the plant.

was obvious that the foregoing
ods could not prevail, and that
deal procedure would be to re-
only that portion of the coal
could not be cleaned, i.e., par-
below 1/50th inch. Accord-
pneumatic methods of dust
ction were introduced, and these
solved the difficulties previously
with, so that de-dusting by air
ation is now a normal procedure
dern coal cleaning practice.

e removal of dust before clean-
oal by wet processes has an im-
nt effect on reducing the quan-
f "slimes" produced in the wash-
ater, and further, considerably
ces the ability of the washed
o drain rapidly. In dry cleaning
sses, preliminary de-dusting in-
es the efficiency of stratifica-
f shale and coal, and as the dust
s contains a higher percentage
isture than the larger particles,
emoval of this fraction elimi-
one of the chief difficulties
with.

previously stated, fine particles below 1/50th inch (some observers place this limit at 1/25th inch) are not washed out but merely wetted, and this is a cause of a large proportion of trouble and loss, more especially when the shale, or adventitious dirt, associated with the coal is of such a nature that it easily amalgamates with the water. In the absence of de-dusting appliances there is a progressive accumulation of fine particles (coal and dirt) in the water, necessitating a quantity of "slurry" being generally run to waste, or alternatively, evacuated each week-end. As the quantity of solids in suspension in the water increases, it be comes difficult to effect proper separation of coal and dirt, while the moisture content of the "smalls" increases due to the greater difficulty of dewatering. In addition, the washed products have a "slimy" appearance—unless large volumes of spray water are used—and this militates against sales.

By removing the slurry forming material in a dry condition, and only washing de-dusted coal, the foregoing difficulties are practically eliminated.

These facts are well illustrated by two plants under the author's control, both of which are dealing with similar coals. The washeries are of the "BAUM" type erected by Simon-Carves, Ltd., one being of 200 tons per hour capacity, while the other is of 125 tons per hour capacity. The former plant is four years old and has no de-dusting apparatus, while the latter was started in September 1932 and has a Simon-Carves de-dusting plant incorporated. As a result of the experience gained with de-dusting at the latter plant, and the economies derived in the washery, arrangements are being made forthwith to equip the former plant with similar de-dusting apparatus, and this applies also to a third washery of 160 tons per hour capacity. It should also be pointed out that the coke made from the washed de-dusted coal is superior to the coke made from the other coal, and this has also been a contributory factor in arriving at the decision to install de-dusters. The figures quoted below are for the product below half-inch (round holes) all of which is used for coke production.

	Tons per hour	
	(200 tons)	(125 tons)
	Per cent	Per cent
Ash content of material from slurry shakers	16.0	7.5
Ash content of "smalls" before addition of slurry and dust	5 5	4.5
Ash content of "smalls" after addition of slurry and dust	6.5	5.5
Moisture content	10.0	6.7
Ash content of dust	(No de-dusting)	9.5

The figures are an average taken from daily samples over long periods and prove conclusively the beneficial effect of de-dusting. A further point that should be stressed is that coal which has been de-dusted before washing presents no difficulties in discharging from wagons, whereas in all other cases the coal is very prone to be sticky and requires more labor for discharging. This, of course, refers to the washed "smalls" below 1/2 inch.

The dust recovered by air separation is invariably lower in ash content than the same size of dust in the raw coal, or even the same size obtained by screening. This is due to a distinct density separation brought about by the air stream and this separation is very considerable in the case of raw dust with a high ash content.

De-dusting enhances the washery efficiency and enables uniform results to be obtained, so that the washing water can be used indefinitely, practically in a closed circuit because no thickening takes place.

Another important advantage of de-dusting is that the volume of effluent that it is necessary to discharge to maintain good washing results can be considerably reduced, and owing to the smaller quantity of water retained by the "smalls", the amount of "make-up" water can be likewise reduced.

Finally, the production of "slurry" and the difficulties associated with its handling and disposal are largely eliminated, while the small quantity that is produced is bright in appearance, low in ash, and much easier to dewater than is the case on plants where no de-dusting is practiced. As a result, the "slurry" can always be re-added to the "smalls" without detriment, as may be seen from the figures previously quoted.

Desirable Features in the Design and Operation of a Pneumatic De-Dusting Plant.

The first essential of any de-dusting plant is that it should be capable of removing the maximum percentage of dust below any desired size from damp coal in which the "fines" contain from 6% to 8% free moisture and at the same time remove a minimum of oversize particles. The dust should be blown away from the air gaps, or louvres, so as to prevent clogging them, and also avoid the dust from falling through them to l up in the dusting. In this way saturated coal can be passed the apparatus without the neces- of by-passing, and without ren- ıg the plant inoperative due to kages.

ıe raw coal should be very gently ed through the air separator to l breakage and prevent the for- on of more dust, and during this age the coal should be loosely re- ed to permit of thorough scrub- by the air, without excessive sure drop so as to ensure a high iency of extraction. Where pos- , the air circuit should be a d one and so designed as to give eat and compact arrangement out unnecessary bends in the ing which would give rise to de- ion of dust and excessive wear to the abrasive action of the dust. rther advantage of a closed cir- is immunity from dust nuisance out the provision of bag filters, ugh it is recognized that when ing with damp coal it would be ntageous to pass a certain vol- of the air to the atmosphere and it fresh air to the circuit to pre- the deposition of moisture in lucting. It is important that the gn of the plant should permit of control and enable immediate ition in the size of dust recov- . It should occupy a minimum oor space and head room to en- it to be fitted into existing wash- without the necessity of re-ele- ıg the de-dusted coal.

is also important that the system tance of the apparatus, includ- the cyclone separator, ducting, etc., should be kept as low as possible so that a minimum of power is absorbed by the fan which should be placed on the outlet side of the dust separator to avoid excessive wear which would otherwise occur if it were handling heavily dust laden air.

Finally the ducting and apparatus generally should be of rugged construction, the cyclone separator should be capable of giving a high efficiency, and the plant should be moderately priced.

There are many practical difficulties in the successful handling of coal dust, and it is important that a thorough examination of the dust likely to be produced should be made before finally deciding on the use to which it should be ultimately put.

In some instances the dust can be re-mixed wholly or partly with the washed "smalls" provided the resultant mixture is within the required ash limits. If the dust has a high ash-content it can be mixed with the small amount of "slurry" and burnt on Lancashire boilers. Alternatively, it can be used as pulverized fuel for it possesses the advantage of being practically free from pyrites or other hard material, so that the wear and tear on the pulverizers is greatly reduced.

In the case of washed "smalls" used for coking, the addition of dust considerably lowers the moisture of the mixture, and, furthermore, provides the very valuable fusain fraction which considerably improves the resultant coke.

The description of the plant is as follows:

RAGE ANALYSIS OF DUST REMOVED BY THE PNEUMATIC
ANT AT THE WASHERY PREVIOUSLY MENTIONED.

(Capacity—125 Tons per hour)	Per cent	
ture	4.7	
	9.5	Dry basis
hur	1.6	
tile Matter	28.1	

SCREEN TEST:

Above 10 I. M. M.	2.5
10 to 20 I. M. M.	14.6
20 to 40 I. M. M.	38.5
40 to 60 I. M. M.	15.5
60 to 80 I. M. M.	3.3
80 to 100 I. M. M.	9.1
100 to 200 I. M. M.	10.7
Below 200 I. M. M.	5.8

EXAMPLE OF DE-DUSTING:	Raw Coal Per cent	De-Dusted Coal Per cent	Dust Removed Per cent
(1) Below 50 I. M. M.	3.8	0.4	90.
(2) Below 50 I. M. M.	4.5	0.9	80.

Example of Variable Size of Dust Obtained By Adjustment:

GRADING:	Fine Dust Per cent	Coarse Dust Per cent
Above 1 m/m		13.4
1 m/m to 1/2 m/m		18.4
1 1/2 m/m to 1/4 m/m	9.5	23.5
1/4 m/m to 0	90.5	44.7

EXAMPLE SHOWING ABILITY TO HANDLE DAMP COAL:

	Free Moisture. in aspirated dust Per cent	Size of Dust
(1)	8.5	Thru 1/16 inch
(2)	8.5	70% thru 1/50 inch

EFFICIENCY OF SEPARATION:

Dust below 30 mesh in raw coal	Recovered dust below 30 mesh	Efficiency of Extractor
3.36 tons	2.94 tons	87.5 per cent

H. A. Treadwell: I wish to thank all you gentlemen who have prepared all these fine papers on coal cleaning.

In the State of Illinois, we have in past years gone into the preparation of coal. A number of years ago there were quite a few wet washers. In recent years we have gone to hand cleaning of coal. However, in the last few years we have run into some serious competition. Therefore I feel that this mechanical clea ing is of vital importance to the Il nois coal industry.

During hand loading we all kno there was very little cleaning unde ground for coal under 3 inches. Ou analysis and watching has proved us that mechanical loading has n made our small sizes of coal ar cleaner.

KINK BOX

H. Taylor, Jr.: We have had
a good response on our re-
s for papers for the "Kink Box".
l read each paper, and the dis- cussion, if any, on that particular subject will be held before going on to the next paper.

USE OF DYNAMIC BRAKING FOR EMERGENCY STOPPING OF HOIST AFTER FAILURE OF FRICTION BRAKE

By DAVID W. JONES
Valier Coal Company
Valier, Ill.

riction brake is in general use
owing down or stopping the
g drum of a Mine Hoist, by con-
g the energy of the descend-
oad into heat. The wooden
of the brake resist the motion
drum with a force due to slid-
ction. The coefficient of fric-
which is a unit of resistance,
ses as the speed is increased.
er words, for the same brake
re applied, the coefficient of
shoe resistance at 60 miles per
s only one-half the coefficient
ke shoe resistance at 20 miles
ur. If a hoist is moving at a
ate of speed and the brake is
plied a sufficient length of
advance, it can not be stopped
it reaches the landing, al-
there would be no difficulty
pping through the same dis-
when traveled at a slower

usual Electrical Hoist with an
rated brake requires power to
the setting of the brake by
ce of gravity. An emergency
valve is operated by a sole-
onnected across the circuit
and in case of a power fail-
to the opening of the circuit
the solenoid becomes inoper-
nd the oil valve closes by gravity. This causes the brake to set immediately. But suppose for some unexplained reason the friction brake does not hold, due to lack of pressure, burnt wooden friction blocks or slippage due to unintended lubrication of some sort,—how can the hoist be stopped?

The Engineer can open the circuit breaker and thus operate the emergency control for the brake, but it would not be any more effective than the hand controlled brake against a fast moving brake drum having a very low coefficient of friction.

Dynamic Braking is the solution. If a properly designed resistance is automatically connected across the terminals of a Direct Current Motor when the emergency control is made effective by the opening of the circuit breaker, the energy of the revolving drum will generate electrical power by converting the motor into a generator, and this power will be absorbed by the resistance across the motor terminals. The energy of the revolving drum will be dissipated as heat from the electrical current in the resistance. This external electrical resistance must provide a greater load than the revolving motor can carry without slowing it down to a very slow speed.

Slowing down the speed of an electrical motor by the electrical force it generates is called Dynamic Braking. This form of control does not injure the motor in any way and is a positive means of retarding speed. The heat dissipated is in a resistanc external to the motor and if the re sistance is freely ventilated a ver large amount of energy can be ab sorbed in a comparatively short tim

ADJUSTABLE CLEVIS FOR QUICK TAKE-UP ON NEW ROPES

By JOHN STAMPER
Top Foreman, Mine 58, Peabody Coal Co.
Taylorville, Ill.

This device is made up like a pair of fish plates for track joints only they are much heavier and are longer.

These plates are made of two pieces of 1½″x6″ plates 29″ long, preferably of Norway iron. This device lets you take up the rope thre times, 5″ each time, before the clamp have to be disturbed and it work very well where step up drums ar used because 5″ is about the amour of take up needed to keep the rope in balance.

SAFETY IN SHARPENING AND DELIVERY OF DRILL BITS

By LEE HASKINS
Superintendent, Mine No. 1, Bell & Zoller Coal & Mining Co.,
Zeigler, Ill.

Mine No. 1 of the Bell & Zoller Coal & Mining Co., Zeigler, Illinois, is 100% mechanical loading mine, ing twenty-four sets of loading crews crews which requires twenty-four sets of drillers. Also the coal is shot with Cardox 100%. The Cardox shells being 2-1/2″ in diameter requires a drill bit of 3″ in diameter. After trying out about all the different makes of drill bits on the market, we decided to standardize on the Coal-Master Drill Bit which is a four-prong bit of heat treated steel and is of very hard material and cannot be filed with a common file, therefor has to be sharpened on an emer stone. We first sharpened these bi on top in the blacksmith shop and d livered them on the night shift.

We are now doing this work dow below. Having five motor generato set stations located in the five diffe ent sections of the mine, we i stalled a small electric emery ston grinder in each station and the ma in charge of the station does th grinding of the bits as he has plent of spare time to do this work.

When the bits are sharpened the

e put on the main line motors and ken to the main parting and there ked up by the gathering motor and ken to the driller at the face. These s are strung on a wire and a brass eck with the number of the loading unit put on them so that there can be no mistake made in delivery.

With this system we have done away with a bit sharpener in the shop on top and the work is being carried on very satisfactorily.

REINFORCING ELECTRIC DRILL POSTS

By FRED BURNETT
Superintendent, Peabody Coal Co., Mine 18,
West Frankfort, Illinois

Practically all mechanically uipped mines are using electric ills and are experiencing some uble with the drill posts, either nding or breaking. The question ises as to whether or not a larger d heavier drill post should be ed instead of the smaller and hter ones now in use.

Most of these mines have installed d standardized on a certain number type of electric drill and to change a different number or a larger and vier drill post would cost ad- ional expenditure of money. Of rse, they could buy a number of ra drill posts of the type they are ng, but this would entail extra ense.

A very simple method can be used in repairing and reinforcing the drill post, at practically no cost, which would effect a great saving to the mine costs, both in money and labor. When a drill post is sent out to be repaired, whether it is bent or broken, have the man who is going to do the repairing get the inside measurements of the hollow drill post and saw a piece of wood, preferably white oak, to these dimensions. After the drill post has been repaired, either by welding or straightening, place the drill post in the fire and let it get fairly hot, remove and immediately drive the wood into the hollow post. The drill post has been reinforced by a wooden filler, making it a good solid post, slightly heavier.

STELLITING MACHINE BITS

By THOMAS GARWOOD
Orient No. 2 Mine, C. W. & F. Coal Co.
West Frankfort, Illinois

ou might remember our method holding the bits for cutting ma- nes while the stellite is being ap- d.

nstead of the bits being placed n angle and the operator having nove his position and thus lose his technique, we have constructed a revolving table on which the bits are arranged around the edge and which can be rotated, bringing the bits successively into position for the application of the stellite.

SAND DRYING

By CHAS. BOYETT,
Peabody Coal Co., Mine No. 47
Harco, Illinois

We originally hauled the sand for the electric locomotives into the sand drier in a wheel barrow. The demand for dry sand increased until one man with two stoves working 8 hours could not dry enough sand. He had to wheel it from the pile to the sand house and run it through the stoves and then send it to the bottom through a drill hole. When I caught our sand supply low, I built a track out of 20 lb. rails using steel ties over the top of the stove and out on the ground where the sand would be unloaded on top of it, with an easy grade up to the top of the stoves. Then I built a small hopper out of light sheet iron with a side dump that would hold as much as six ordinary wheelbarrows and to this I attached 4 old Ford Model T front wheels, using the rims for flanges to hold it on the track. The man can get his sand in the stoves so much faster and easier with the car than he could with the barrows, the stoves can be kept full getting the benefit of all the heating surface. More time can be spent keeping the stoves hot and keeping the drier sand out from under them. We use 15 tons of sand each work day.

TRACK SIGNALS PREVENT DELAYS

By W. C. CRAGGS
Superintendent Peabody Coal Co. Mine 43
Harrisburg, Ill.

On haulage road at Mine No. 43, Peabody Coal Co., there are four haulage motors running over the same road. This road is exceptionally busy at all times and as the main road leads directly to the shaft, traffic on it is important.

The signal is a winking light. The lamp was already in place on entry where formerly it was used for illumination and it was only necessary to devise a means of winking when a trip was approaching the bottom or parting. The device designed for the purpose consists of a piece of strap iron spiked to a tie in the road bed. a piece of brass strap is fastened to the iron in such a manner as to be pressed down against another piece of brass attached to a block of wood nailed to the next tie.

One can readily see the action of this device when a trip of cars pass over the rails at this point. The flange of the car wheels closes the circuit of the lamp as they pass over the device. During the interval when a wheel is not running over the switch, the contact is open. This making and breaking device in the circuit of the Lamp causes the light to wink and thus gives a signal out at the junction to the main road.

SAFETY SIGNALS TO PREVENT COLLISIONS

By THOMAS GARWOOD
Orient Mine No. 2., C. W. & F. Coal Co.
West Frankfort, Ill.

t is thought that our safety signal em used in connection with the erground haulage might be of in- est to some of the men. We have course the two tracks along our n haulage ways and into this at tain junctions have motors coming m opposite cross-entries. Having motors arrive at the same time in order to avoid collision at se points we connect our signal ps so that, in giving any motor a ar signal, connections are so made t before the green light is made er red lights (signals to all other s of traffic) are first in con- tion and it is impossible to give r signals to two trips that might ravelling in the same direction or cross into or over that track in use by the other motor. For instance a motor coming out of a west territory headed toward the bottom is given a green light. Red lights are positively on to motors north and east of this point on tracks leading to the bottom but green lights may be given to motors **going inside** to all points but the west entry. Should the motor be coming out of the east cross-entry all other lights are red and no light can be changed on any track since the inbound motors would have to cross his track. We don't have wrecks due to mixed signals when they are properly obeyed by the motor crew.

HAULAGE SAFETY

By A. L. REED
Chief Electrician, Mine No. 18, Peabody Coal Co.
West Frankfort, Ill.

t our mine, all of our main line r roads have steep grades both g in toward partings with emp- and coming out toward the bot- with loads. We use the Monarch lings, and as a safety measure, provided each main line motor two short lengths of wood, ap- imately 20 inches long, which been fishtailed or V'd on one The purpose of these pieces of or sticks are for the motormen tripriders to push clevis of coup- to one side, while motor is go- lown a grade, in bunching their or empties. It is necessary for clevis of the coupling to be pushed to one side in bunching a trip of cars, otherwise the clevis of coupling would ride on the bumper of the motor and derail the front car.

The haulage man, instead of using his hand to turn aside the clevis, used the stock of wood. This piece of wood is made from a 2x4, the V'd end being 4 inches wide, while the end the haulage man holds is narrowed down to about 2 inches and rounded, so as to give him a good grip.

This simple device has saved us many an accident to hands as well as many broken couplings.

HOISTING ENGINE REPAIRS

By HENRY J. KINSMAN
Master Mechanic, Franklin County Coal Co.
Royalton, Ill.

We have a pair of Hoisting Engines with cast iron discs. These engines were installed in 1919.

About 1923 we began to have trouble with the Crank Pins and up to December 12, 1925 we changed 3 Pins on the left-hand engine. Upon close examination we found the bore to be 0.012″ out of round and a crack in the disc on the pillow block side extending about 2-1/2″ deep and about 3″ down towards the hub. This discovery taxed the man in charge, which fell to the writer. Obviously it was necessary to shrink a band on the disc to close the crack. Next, the hole being out of round and nothing on the grounds to rebore the hole with, the idea occurred to shrink the band on and make an oversize pin at draw. Next, where to get a band of that size. Fortunately a switch engine's driving wheel tire was measured and found to be what we wanted. A local machine shop turned it down to a shrink fit and the band was shrunk on. In the meantime the Pin was made at the mine, with a shank 2-1/2″ in diameter, extending 14 inches past the proper length of Pin with about eight inches of threads; 6 threads to the inch, which were used to pull the pin into the disc. The Pin was made 0.005 inches larger than the smallest diameter and on the last 1/2 inch we had to use a ram to assist the screw in drawing it in. The local machine shop's cost including the old tire was $91.82. The new Pin was made of an old sheave wheel shaft and our labor included, the total came to $165.00 and we only lost two days work.

Although we ordered a new steel disc which arrived about five weeks later and cost $425.00, we decided to do the same on the right-hand engine a few months later, on account of the time and expense of changing discs which would have taken about five days and cost $350 for labor. These pins have been in for over seven years and show no sign of loosening.

REPAIRING BLOWER TUBING

By THOMAS GARWOOD
Orient No. 2 Mine, C. W. & F. Coal Co.
West Frankfort, Ill.

First we might mention the trouble of connecting blower tubing that has been cut short of original lengths. To overcome this we use short sleeves of galvanized iron with a groove rolled in one end. We then slip the tubing over this from both ends and tie a wire around it to hold the tubing in place. There is an eye in the sleeve for hanging to some point in the roof, or rib. For the support of this tubing we use the "Yankee' drill and make 11/64″ holes into which we insert a small wood plug and drive a nail. This nail is bent over and a wire stretched from them to hang the tubing from. This small push type "Yankee" drill is handy for this work.

QUESTION BOX

By J. E. JONES

Safety Engineer, Old Ben Coal Corporation

estion: What do you do to keep idle electric equipment from "sweating"?

swer: Cover with a canvas and put an electric heater of about 250 watt capacity to 1,000 horse power motor during winter months.

estion: What do you do to reduce burn-outs in electric motors?

swer: Wind the fields and armatures in asbestos covered wire using mica or asbestos installation and asbestos tape; using high temperature solder.

Discussion notes: Armature and fields will stand 400 to 500° F. Formerly 212° F. was the limit and can be done for one-half the cost of cotton covered coils from the factory.

stion: Mantrips at night have been a source of danger because of the rush to save a few minutes after quitting time. Discipline is of some value but speed has gradually increased after each drive for safe handling of mantrips after quitting time.

Answer: A successful method now in use is for the generator attendant on the surface to lower the voltage to 175 (or that required as to distance) at once after the whistle blows. The maximum speed from this procedure is four miles per hour.

5-D

To reduce fire hazard from electric short circuit at night and on idle days the circuit breaker is readjusted for a lower amperage kickoff. The normal amperage kickoff is replaced at the starting time.

5-E

Question: Since night shifts began they have been blamed by the day shifts for most of that which goes wrong — especially misplaced equipment. Sometimes this is warranted but most of the time it is not. What have you done to place responsibility in this respect where it belongs, thereby lessening the waste of time and material?

The following papers by C. J. Sandoe, David W. Jones, G. S. Jenkins, John E. Jones, and G. G. Crowder—all members of our Institute—were presented at the 1933 meeting of the American Mining Congress at Pittsburgh and were published in "Coal Mine Mechanization" yearbook for 1933. We are grateful to the American Mining Congress for their full permission to give these papers to you herewith.

EFFECTIVE BLASTING MEANS INCREASED PROFITS AND SAFETY

By C. J. SANDOE
Vice President, West Virginia Coal Company of Missouri

Much is required of a modern coal operator in the way of constant study and experimenting to reduce the cost and improve the quality of his product so that he can more effectively meet the constant competition and pressure from other fuels. To this end in the mines of our company, we have been doing some studying and experimenting in connection with the blasting of coal. Much has been done along this line by students of mining generally and we have really only been taking advantage of their efforts. Properly speaking, our work has been limited to the application of methods devised by others to our own conditions and a study of the results to determine whether or not these methods are profitable. The subject of blasting of coal suggests immediately to the operator two important problems: First, that of protecting the employee from the hazards resulting from the same; and, secondly, that of improving the quality of the coal shot down for selling purposes in so far as the blasting may affect the coal.

In powder blasting, we are all familiar with obnoxious gases, fires, smoke, and the shattering forces that sometimes creep into the roof loosening the top coal and rock and the falls resulting therefrom. These are some of the ordinary hazards with which men working at the face are constantly confronted where powder is used for blasting. These hazards actually are the cause of many of our most serious accidents. We are also familiar with the shattering effect of powder on the coal. A slight drop of a large lump of coal will sometimes collapse into screenings. We have all had complaints from the screenings in the cars at destinations. This is not all due to improper screening or preparation. Some is the result of the shattering effect on the coal from blasting, coupled with the jarring received in transportation.

The problems connected with blasting of coal have apparently always been a constant source of great worry to the operator, and much experimenting has been done to overcome these problems. Most of the study has been toward controlling the force of the explosion so as to concentrate the energy from the explosion in a certain spot or in a certain direction Recently, I was told of a novel device that was patented in 1854 and had for its objective this very thing. In later years, an effort has been made to obtain the same result by heating water and creating a steam pressure Still later, we have had the safety cartridge, the explosive cartridge and several devices called blasting cartridges. None of these were generally used until the different grades of powder were put in pellet form Permissible powder has been introduced to aid in heavy blasting.

ere has also been developed ng our present-day methods a of blasting through the expansion of gases. This method is known ardox blasting and it is to this od that I desire briefly to call attention. In the course of our rience, I believe we have tried all he proven grades of explosives. ovember, 1931, we made our first of the Cardox method of blasting coal at our St. Ellen Mine, near llen, Ill. In this test we were inted in the two problems mend—the safety factor, and the ng of a better grade of coal. At particular mine, we have a lime roof and no large quantity of After many obstacles in the way terference, other than the actual ling of this particular method, ound that this method of blast reduced our accident hazard and oved the quality of our coal. The r improvement was revealed in sales realization and this, I be, is the ultimate test.

e coal at St. Ellen mine is d with the larger type mechaniaders. Machines of this type add e breakage in the coal where the has the slightest tendenccy to er. Nevertheless, in using Car blasting with this type of ma, we have made a reduction in 2-inch screenings of approxily 19 percent. The greater part e reduction has been in the numour and five sizes and the great ncrease has been in the 6-inch which is increased approxily 13 percent. In the 6 by 3 egg, there has been an increase pproximately 6 percent, while the 2-inch and 2 by 1½-inch have ined about the same in percent This would seem to justify the usion that coal blasted through method would handle much bet than that blasted by powder. I might mention, also, that an improvement is noticed in the appearance of Cardox blasted coal. It seems brighter and cleaner. The impurities in the coal are usually along the fracture of the coal and with Cardox blasting the fracture seems to follow more generally natural lines and as a result the coal is more easily cleaned. Also, due to the reduction in the number four and five sizes, there is a marked improvement in the quality of the 1½-inch screenings.

As a factor in reducing our accident hazard, our limited experience has shown that Cardox blasting is most effective. Although I do not want to appear an extremist or partial toward Cardox blasting, it actually seems to me that as I study it and the results we have had, the use of this method is one of the greatest steps toward safety and health of the miners that has been introduced in the mines in a number of years. Obviously, it makes for the elimination of obnoxious gas and smoke in rooms where miners have to work. In the loading of coal with the large type mechanical loaders, there is very little coal dust held in suspension in the air, eliminating nose, throat, and lung irritations to the men working. The hazard of mine coal fires is done away with and with it goes the dangers connected with the sealing off of the same. The danger connected with the handling, transportation and storage of explosives in the mine is eliminated and the possibility of dust and gas explosions from blasting coal has been reduced to a minimum. Cardox blasting appears to have little effect on the roof and walls and since we have been using it we have had less falls at the face than before. Falls, I believe, account for the majority of serious injuries in the mines. Since using this method, we have really only had one accident resulting from the Cardox blasting itself. This accident occured shortly after we began blasting in this manner. A shot-firer was struck on the leg by a flying shell because he was careless and did not obey rules. He was superficially bruised and lost only three days. Although the miners, at first, were slow to accept this system of blasting, they have rapidly come to appreciate its advantages and, I do not think I am exaggerating, when I say that our men now prefer it to the other method of blasting. It is my firm belief that while the first cost of the Cardox method is more expensive than powder, our own experience has warranted its continued use in that we have increased our sales realization as a result through the improvement of the quality of our coal, the reduction of the percentage in minus 2-inch coal, and by the reduction of the accident hazard.

GATHERING IN RELATION TO MINE HAULAGE

By DAVID W. JONES
Superintendent, Valier Coal Company

Mine haulage designated "Gathering," covers the movement of cars between the main line haulage partings and the working places where coal is loaded into the mine cars.

The particular means by which mine cars are loaded determine the method of gathering required to give the most efficient operation.

Three general headings will classify the usual systems of gathering, as follows:

(1)—"Gathering" mechanically loaded coal.

(2)—"Gathering" conveyor loaded coal.

(3)—"Gathering" hand loaded coal.

Gathering mechanically loaded coal may be subdivided into three types, as follows:

(A)—Gathering with two battery locomotives for each loading unit.

(B)—Gathering with two reel locomotives for each loading unit.

(C)—Gathering with a single locomotive for each loading unit.

Relaying for Gathering Locomotives:

Locomotives gathering for mechanical loading units require the assistance of relay locomotives to move the empties and loads between the main line partings and the immediate vicinity of the mechanical loading units. Locomotives gathering conveyor loaded cars and hand loaded cars do not require the assistance of relay locomotives.

Methods of Gathering Mechanically Loaded Coal:

(A)—Two battery locomotives gathering for a mechanical loading unit will provide a fast means of changing cars and give a high ratio of loading time to time required for car changes, when the haulage conditions and grades are not such as to cause reduction in locomotive speed due to battery exhaustion.

In determining whether one or two locomotives should be used in connection with a mechanical loading unit, consideration should be given to the maximum number of cars it is possible to load under the existing conditions within a given time by operating the machine continuously. If for instance, it is estimated that there is a possibility of loading, say, not more than 250 tons per shift under the most favorable conditions, it is ques-

whether the second locomo-
uld be warranted in the oper-
Iowever, if there are no lim-
atures in connection with the
conditions and the number of
ssible to load depended en-
pon the availability of emp-
loading, the second locomo-
uld be worth the investment,
g an excessive outlay of capi-
t required to supply the loco-
The added expense in addi-
the locomotive investment
e the labor of one motorman.
prider could be employed in
on with the operation of two
ives by remaining at the proper
throw switches and couple
s. Each of the locomotives
e operated by the motorman
locomotive turned so that the
an could couple the cars to
comotive and observe the
g and spotting of the car
nder the conveyor in order to
ll and evenly. Practically no
an be made by employing two
ives for changing cars when
e is located within 100 feet
e entry. If the locomotive
n the room is as far as 150
e traveling time required of
motive in and out of the room
ut the load and spot an empty
loading machine is longer
time required by the loading
for maneuvering to clean
working place and get set for
t operation. When the depth
room exceeds 150 feet, the
quired for changing cars can
e shortened by laying track
a cross-cut and connecting
ks in two adjacent rooms. The
n in this case would be about
ws:

notive No. 1 has just finished
a car under the loading ma-
nveyor, moves out to the entry
ces the load on the entry inby the working room, then moves back to the room outby the working room and couples on to three or four empties. Locomotive No. 2 which has been standing in the cross-cut coupled to an empty follows locomotive No. 1 until it clears the cross-cut switch and then moves forward to spot an empty under the loading machine conveyor. Locomotive No. 1 has by this time re-entered the working room with empties and switches into the cross-cut in the place just left by locomotive No. 2. This completes the cycle and the loading machine was waiting for an empty only the time required for the first locomotive to move the short distance to the cross-cut switch and the time required for the second locomotive to take its place under the loading machine conveyor.

(B)—Gathering with two reel locomotives for each loading unit.

If the conditions are not favorable for the operation of battery locomotives and it is necessary to use reel locomotives, similar methods of gathering may be employed, except the location of the trolley wire must be given special consideration to prevent interference of cables in the operation. The usual practice in hanging trolley wire is to place it on the cross-cut side of the entry where it presents very little hazard for men, as well as cars, passing under it. However, under this arrangement when a locomotive is in a room the cable is stretched across the track and it is necessary for the triprider to stand by it constantly and see that it is not run over when the second gathering locomotive or the relay locomotive passes on the entry, setting in empties and pulling out loads as the case may be. Where there is sufficient height and the roof conditions are favorable, all cable interference among locomotives can be eliminated by placing the trolley wire on the room-neck side of the entry. Under this arrangement the cable will not be across the entry track while the locomotive is in the room. Sufficient clearance should be provided for men and loaded cars to pass under the trolley wire. There is the constant hazard, however, that should the trolley wire fall it will lie across the room tracks. It is not advisable to extend trolley wire into rooms and for this reason changing cars inside the rooms by the cross-cut switch method is not possible, the same way as suggested for the use of battery locomotives where the depth of the room is beyond 150 feet. However, reel locomotives have greater speed and power per ton of weight than battery locomotives which permits car movements over greater distances.

(C) Gathering with a single locomotive for each loading unit:

When a mechanical loading unit is served by a single locomotive, it is the usual practice for the locomotive to be coupled to three, four, or as many cars as the motorman can handle quickly and safely. The triprider remains with the car next to the loading machine and signals the motorman to move forward or backward as required to load the car evenly or permit the loading machine to change position. It is not well to have more than five cars coupled for shifting in this manner as the motorman is not able to control the slack definitely enough to spot the empty being loaded in the proper place. When a loaded car is ready to be pulled out the triprider signals the motorman accordingly, and the load is then set out on the entry inby the working room and coupled to loads which have already been set out. The empty cars brought in by the relay locomotive are spotted in adjacent outby rooms and obtained there by the gathering locomotive when needed.

In rooms where the face is in a distance of 150 feet or more, the cross-cut car change method can be used advantageously to save traveling time of the locomotive, and the operation would be about as follows:

The gathering locomotive will bring in four or five empties as explained above, the triprider signaling movements to the motorman to suit loading conditions. When a car is loaded it is switched in the cross-cut instead of moving it the full distance to the entry. If the gathering locomotive motorman starts out with, say, four empties, he will leave the fourth empty spotted under the loading machine, and while it is being loaded, move away light, couple onto the three loads in the cross-cut and set them out on the entry, then return with three or four more empties and couple to the car remaining under the loading machine conveyor. When loaded it will be set in the cross-cut as just explained. This arrangement has saved several trips back and forth to the entry with single cars and considerably reduced the waiting time for empties for the loading machine.

Relay Locomotives:

The relay locomotives required between the main line parting and the loading machines enable the gathering locomotives to work within a very close distance to the working face. It is desirable to have the distance traveled by the gathering locomotives as short as possible in order to give the loading machines the advantage of the maximum loading time. Of course, it is not possible for a loading machine to load continuously as a certain amount of time is required for shifting into desirable loading positions in order to properly clean up a place. These shifting times do not always occur during car-changing times and for this reason it is desirable to give the loading machine every advantage

aving an empty available for
g the maximum time possible.
ever time is lost after the load-
achine is in loading position can-
e recovered. The movements of
lay locomotives should be timed
t deliveries of loads to the main
arting are made and the haulage
s cleared for the main line when
ives at the parting with empties.
otorman of the relay locomotive
l anticipate requirements and
g conditions of the mechanical
s he is serving and obtain suffi-
empties to keep the loading
nes operating at maximum
ity. If he is serving two load-
achines and they are both in
able positions the maximum
er of empties allowable should be
ble for both of his machines. If
appens that both of his loading
nes are moving into new places
inimum car requirements should
en. Unless the motorman of a
locomotive is capable of using
judgment in anticipating the
requirements of his loading
nes, an efficient distribution of
annot be obtained, and many
s will be stored away and kept
service, or the other extreme
be to have the loading machines
ithout empties to load before
lay locomotive returns from his
the main line parting. Best
s are obtained when the haulage
nd the loading machine crews
n close contact and are familiar
ll movements and prepared for
al conditions. Usually the main
aulage locomotives are timed to
partings at regular intervals.
elay motormen must then time
novements so that they can de-
npties to their loading machines
turn with loads to the parting
the main line locomotive arrives
parting with empties.
veral main line locomotives are operating to the hoisting shaft, it is important to have them arrive there at regular intervals to permit uninterrupted hoisting. If a main line motorman is delayed at an inside parting waiting for relay motormen to clear the empty parting or place their loads on the load parting, it is quite likely that the operations on the main bottom will suffer serious confusion by one of the main line locomotives arriving off schedule and then having to wait in turn to enter with loads and receive empties. Whatever time a main line locomotive is idle by waiting on the main bottom for empty cars is reflected back to an inside parting where a relay locomotive is waiting for the main line locomotive to bring in empties,—and still farther inside the loading machines may be idle waiting for the relay to bring in empties after the last available car is loaded. If the main line haulage functions smoothly and the relay locomotives distribute empties efficiently, not allowing them to remain out of service where not required, the loading of cars will be uniformly and efficiently done. In other words, the production of any loading equipment will not be up to maximum unless the gathering is efficiently handled.

(2)—*Conveyor Loading Units:*

Gathering for conveyors or pit car loaders can be done efficiently by one locomotive and no relay is required. The number of tons to be gathered per locomotive and the number of units serviced must definitely be determined in order to make the operation economical. If for instance, a group of seven conveyors is to be served, the gathering locomotive must have sufficient time to pull the required number of cars from each loading unit to give the tonnage desired. If a group, say, of seven conveyors are served by one locomotive, a good system of haulage is as follows:

At least two working places must be assigned for each loading unit. The gathering locomotive will leave the main line parting with seven empties coupled ahead of it. The load standing under the conveyor in the last working room inby is pulled first by coupling it to the string of empties pushed into the room. This load is then pulled out of the room and spotted on the entry. The empties are again pushed into the same room and the last one spotted under the conveyor from which the load has just been pulled. The load in the next working room is pulled out and another empty spotted in the same manner. This system of gathering proceeds until the last load has been spotted on the entry and the last empty spotted under the conveyor. The locomotive is then coupled to the seven loads which have been gathered on the entry and the motorman proceeds to the parting where he leaves his loads and obtains empties for another cycle of operation. The number of units to be served also depends upon their closeness to the main line parting as the main line haulage might be so timed that a gathering locomotive would make two trips to one of the main line locomotive.

(3)—*Gathering Hand Loaded Coal:*

Gathering for hand loaders requires one locomotive for a pair of room panels and a total from 30 to 40 hand loaders are served by one gathering locomotive. The usual method is for the gathering locomotive to bring in say, 10 empties for 20 loaders, who work double, and drop one empty for each two men. The motorman then moves over to the second panel and starting with the last working place inby, pulls the loads out of the room and couples them on the panel entry. After, say, the 10 loads are gathered, the gathering motorman proceeds to the main line parting where he leaves the loads and returns with another 10 empties which he spots in the rooms from which he has just pulled out the loads. After this length of time has elapsed he is ready to start on the first panel again and pull out loads as previously explained which completes a cycle of operation from the time the empties left the parting until returned loaded from men on the hand loading territory.

In gathering for entries, it is necessary to spot an empty immediately upon pulling the load and this is done more frequently during the early part of the day in order to provide the time required for the men in the gang to cut and prepare the entry face after the coal has been loaded out.

LUBRICATION COST FOR LOADING MACHINES

By G. S. JENKINS
Mechanical Engineer, Consolidated Coal Co. of St. Louis

In discussing this item, it becomes necessary to limit the scope of the discussion to some one phase of operation to keep from wandering into the numerous application of lubricants found in the industry of coal mining. On account of the widely varied types of locomotives—carwheels, motors—tipples, etc., these items will not be discussed, and the lubrication cost will be limited to the cost per ton for lubrication on our loading machines.

This particular type is one widely used in the State of Illinois where the mobile type of mechanical loader alone is considered and loads approximately 31 percent of all the coal loaded in shaft mines in that state. Hand loadccounts for 31 percent, and other of loading machines and pit car rs account for the remaining 38 nt. These figures are for the 1932. From this it can be seen the cost per ton for lubrication ese machines becomes one of the to be considered in the mining al.

e Consolidated Coal Company ed using loading machines early 928 and at the present writing 26 of these machines and a sav- of $.001 per ton on 26 machine operation means a saving of $9, alent to $45 per week if machines operating 5 days a week. he same basis a saving of $.005 d mean $45 a day or $225 on 5 a week operation. Or to take it o the yearly budget the saving be $1,000 on each million tons d *(per mil the lubricating cost is ed).*

ring the past two years the Con- ated Coal Company has managed wer its lubricating costs approx- ly 7 mils per ton and the saving ved is $7,000 on each million tons ced, which at the present time sents quite an important figure. arriving at these figures the are divided into hydraulic oil nd lubrication cost and the total ese two figures represents our Cost."

ring our first years experience loading machine we were show- n oil cost of from 1½ to 2 cents which we managed to get down t over 1 cent a ton by 1931, and g the past two years have main- l an oil cost just over 3 mils per This includes hydraulic oil and ant, and gives us a saving of on each million tons of coal ced.

ing our early experience we ex- ented with several lubricants various degrees of success, burning up numerous clutches and causing considerable delays, and finally decided we had to select some one lubricant and stay with it.

The lubricant we wanted was one that did not break down at the temperatures attained in the loading machines, one that was of sufficient heavy-duty to prevent undue wear in the transmission, and of such a nature as to properly lubricate the clutch plates and prevent burning; one that would not sludge, and yet still be cheap enough so that the leakage loss would not be prohibitive.

At that particular time there was a trend toward lighter lubricants, and as we were putting 10 new machines into operation at our Herrin Mine, we decided to give the theory a try, despite warnings that we might experience burned clutches and worn gears in a short time. Our experience was such that after several months we adopted the use of oil as the lubricant in all our machines. Our experience being that the lubricant temperatures were lower with oil than with grease and the viscosity of the oil at the operating temperatures was higher than that of the grease.

As these 10 machines have been on our present practice from the beginning, and have at the present loaded approximately 100,000 tons each, we will limit the discussion for the present to these 10 machines as there can be no credits or deficiencies attributed to other lubricants.

As to the efficiency of the clutch lubrication, we haven't had a stuck or burned clutch at the present writing. Inspection of the gears in the transmission shows them to have no visible signs of wear and they have never been out of the machines.

There is no resinous residue on the clutch plates and several of the machines were flushed out during this year and no residue present. Other lubricants on the market would probably perform equally as satisfactory —perhaps more so, but our experience is such that we see no great advantage in further experimentation.

This brings up the question of maintenance. Are the machines properly lubricated? We feel that were they not properly lubricated after loading 100,000 tons a machine would begin to show signs of wear, and mechanically the machines are practically as good as new. Incidentally our maintenance cost per ton on these machines for their entire life is just under 1 cent per ton. This figure includes labor and material—about 65 percent being material and the remaining 35 percent labor. The spread on the cost on these 10 machines is from about 3 mils for the lowest machine to about 2 cents for the highest one. As to the cost during the past 6 months, it is running under the average for the life of the machines—both as to labor and material. The labor scale, of course has been reduced from $.76¼ per hour to $.75 per hour; but this is negligible. Material, however, has dropped somewhat more. Our peak cost per ton was encountered during the first six months of service. This, however, was due to the operators learning to run and not knowing just how to handle the machines. Incidentally all repair parts used in maintaining the machines are genuine manufacturers parts, and the low maintenance figure is not accomplished by replacing with cheaper parts.

As to the method of lubricating the machines. It is done on the night shift—the night shift crew consists of 3 men, 1 repairman, 1 head greaser and assistant repairman and 1 greaser. The greasing truck is towed with a battery locomotive. While the repairman inspects the machine and makes the necessary repairs and adjustments the other 2 lubricate the machine. Should the machine need further working on the repairman has the head oiler help him, while the oiler moves on to the next machine. We find that we have no trouble greasing the machines using this layout and at the same time have a competent man constantly on the job. In some mines the machines are greased during the operating day and this works out very satisfactorily. However, we are working the machines on a concentrated territory—10 machines in 5 consecutive panels, and the amount of traffic rather prohibits the transportation or the grease truck during the operating shift.

Regarding the lubrication. A new machine will give about 20 tons per pound of lubricant or about 150 tons per gallon of lubricant. The loss is accountable only to leakage as the lubricant actually consumed is negligible. The main points of leakage will be taken into consideration and the method in use in deciding when to try and remedy a leak.

We consider that 15 tons per pound or about 120 tons per gallon as being about all we can economically expect out of the machines, and as long as a machine approximates this we feel satisfied. Where a machine falls below this we check it over to find the source of the leaks.

One very satisfactory way of doing this is to run the machine up over paper and allow it to run. The oil shows very readily on this paper background.

One of the sources of leaks is the front clutch located under the gathering head and attached to the motor housing. This clutch is of the disc type and runs in a lubricant. The housing is split with ground joints and practically leak-proof. However, considerable leakage is experienced t the opening through which the rmature shaft extends into the lutch housing. A leak at this point, an be stopped by repacking the joint, hich requires about 30 to 40 hours abor at $.75 per hour or from $22.50 o $30 worth of labor. We feel that repair job should pay out in 100 hifts to be worth while; so consider- ng the price of the lubricant, a leak t this point would have to amount o 3 to 4 quarts a day to make any et saving, otherwise the expense of epairing would amount to more than he lubricant you would lose during 00 shifts.

Another source of leaks is from the ransmission case. This case is made p with ground joints and if care is xercised in taking it apart and re- lacing it, not to damage the ground oints, it is practically leak-proof ex- ept through the openings in the ides for Timken bearing supports. These supports are cap-screwed to he case and if care is taken to get ap-screws tight and wire them, this ource of leak should be practically egligible. However, the caterpillar rive shafts extending through the ide of the case, are supported by earings which are ground, and cap- crewed to the case. These cater- illar drive shafts are subjected to onsiderable punishment which tends o loosen the cap screw; so a fre- uent check of the bearing supports s necessary. We have found that heet packing between the joints has elped considerable; lessening the endency of the cap screws to become oosened.

Probably more lubricant leaks round the brass bushing of the drive haft bearing than between the case nd the bearing. These bushings arry all of the caterpillar drive and he punishment they receive makes hem subject to considerable wear. As he lubricant level is carried well up on the drive shaft there will be considerable leakage at this point as the bushings wear, especially when operating in a position where one side is higher than the other.

To replace this pair of bushings means $6.70 material and 6 hours labor or $11.20, which would necessitate saving about a quart of lubricant a day to make a real net saving.

Probably one of the most common sources of leaks is the rear conveyor or side clutch. This assembly is partitioned and both halves require lubrication. The front half contains a disc clutch. It is imperative that this compartment be well lubricated to prevent the discs from sticking and burning; which would happen, should they run dry.

The most likely point for the lubricant to escape is through the bearings and into the rear compartment. There is considerable tendency in this direction as the oil level in the rear compartment is found to increase at the expense of the level in the front compartment. The rear compartment is connected to a grease reservoir that extends over and around the swinging rear conveyor center shaft. This reservoir must be full to allow grease to remain in the side clutch rear compartment. The most likely place for lubricant to leak then is through this hopper reservoir.

The rear conveyor swings on a Timken bearing and the overhang is supported by rollers. These rollers must be carefully adjusted to maintain as true a balance as possible, and to keep any unnecessary wear off of the packing while swinging the conveyor. Any leak through this packing runs down the sides of the machine below the hopper. The vertical center shaft which drives from a position between the forward and reverse gears in the transmission also must be packed to prevent leakage directly into the transmission case. To replace either of these packing rings requires the removal of the rear conveyor assembly, so both are usually packed while the assembly is off. This job requires $1.30 worth of packing and about 30 to 40 hours labor. This means a saving of about 3 or 4 quarts of lubricant must be realized for a net saving.

The above examples are indicative of the manner upon which we determine the advisability of correcting oil leaks in the lubrication system.

As for the hydraulic system, we use red engine oil in this and get from 200 to 400 tons per gallon, averaging close to 300. We have tried ordinary "hydraulic oil" and find that the action is too sluggish and a heavier oil gives too fast an action. Just the contrary to what one would expect. Regarding the new rubber pressure hoses for the hydraulic system, our experience has been that they give increased life wherever they are not subjected to chafing—or come in contact with oil on the outside. Where those conditions are experienced we find the metal hose gives the longer life. One condition noticed is that where rubber hoses are put on the swing conveyor jacks—it slows them up slightly, probably due to the rubber hose having a smaller opening. However, this does not impede the production any and is easier on the machine.

One item that might be of interest to some is the lubrication of the motor bearings. If these grease cups are filled every night, the operator has a tendency to turn them down at intervals. This tends to get grease into the motor cases and leads to various troubles. We find that sufficient lubrication is obtained by filling the cups with high temperature grease and turning them down and leaving them empty, once every 12 shifts—this takes about .4 pound of high temperature grease per machine once every 12 shifts; and by buying this grease in 5-pound cans and lubricating the motors all at the same time a clean lubricant is insured and the additional cost in small containers is negligible.

If idle time is encountered we lubricate the machines on the night prior to the working day. As some leakage takes place while machines are standing idle this requires a slightly larger amount of lubricant, but insures a fresh and adequate supply on the working day.

Along this line some people advocate only filling the reservoirs to the lower level on the gauge. This is like running your automobile with your oil level at the low mark on the gauge. You will cut down your consumption, but you are taking a chance if a small leak starts during operation.

Another practice frequently encountered is throwing a few pounds of high temperature grease into the side clutch to prevent leakage around the vertical shafts. This stops the grease from leaking, but also probably stops adequate lubrication of some of the necessary parts.

It might be mentioned here that the lubricant consumption is more dependent on time the machine is running than the number of tons going over the machines. However, during a work day the tonnage loaded by different machines will probably not vary to a degree to very far affect the cost on a per-ton basis which is the customary method of cost accounting in the coal mining industry.

As a final check on our lubricating cost, an inventory of loader lubricant is taken each year and our yearly purchases checked against the consumption sheet turned in by the oiler and so far we have checked out all ight. Of course, this means the last iachine lubricated from a barrel is harged with the difference of the lubricant used and the contents stamped on the barrel. This compensates for any mistakes in measuring.

MINE FAN ECONOMY

By J. E. JONES
Safety Engineer, Old Ben Coal Corporation

Successful mine operation includes he application of as great a variety f scientific knowledge as does posibly any other type of industrial acivity. Such knowledge embodies an qual amount to that required by ny other industry on the face of the arth, but added to it is the need of rtificially supplying underground hose necessities taken as a matter of ourse on the surface. Chief among hese is ventilation, and the chief sinle factor in ventilation is the mine an.

Mechanical ventilation of mines is ow wholly obtained with fans. There as a time when mechanical efforts in orcing the air down by the cylinder nd piston principle were made, but hese all disappeared with the advent f the fan. However, when one coniders the fan as a set of cylinders nd centripetal force as a piston to ach cylinder, there is a connection f thought between the two.

There is probably no operating nechanism in or about a coal mine he principles of which are so little nderstood by the managements as hose of the fan. The average mangement can intelligently direct any letail of any other department. With he fan, however, the limits of undertanding are usually the mechanical naintenance and variation in speed. The fan is that piece of equipment vhich, above all others, the managenent accepts, bewildered as to its fficiency. The evolution of every it of progress in and about a coal nine is at least partly attributable to the "men at the mines" with the exception of the fan. The fan designer is neither assisted nor bothered by the mining men in his study and efforts. They accept what he has to offer, their only demands being original cost and that the fan delivers the quantity of air desired.

There is probably, also, no other operating mechanism in or about a coal mine that operates with greater regularity and gives less trouble than the mine fan. Its efficiency, therefore, has been taken by the management as a matter of course. After installation it is all but forgotten, a maximum of attention being given elsewhere, in spite of the probability that the fan and the mine are no longer properly mated, perhaps were never so, and in spite of the fact that the fan probably uses one-fourth of the power used at the mine.

In the evolution of mine fans the tendency in recent years has been from the large slow-moving fans to the smaller and speedier ones. From historical data of the Illinois Mining Institute Proceedings of 1929 we find, "It was late in 1891 . . . that Mr. James C. Simpson, general manager of the Consolidated Coal Company, invited the state mining board and inspectors, and other mining men of the state, to visit one of the company's mines in Staunton, and to spend the day in mining discussion and good fellowship. The nucleus of the meeting was the inspection of the recently installed newest type mine fan. This was a Guibal type fan, 30 feet in diameter (for mines Nos. 8 and 9). At the dinner given by Mr. Simpson on that day, it was proposed that an institute be organized, and the date of February 17, 1892, was fixed for the preliminary organization." The Illinois state coal report for 1893 shows that this fan, running 62 revolutions per minute, water gauge of 2.2, and volume of 163,000 cubic feet per minute, was belt-driven by a pair of engines 18 inches by 36 inches. The same report states that mine No. 7 of the same company had a 20-foot fan giving 92,000 cubic feet per minute at 72 revolutions per minute and 1.4 inches of water gauge. It further states that the Pana Coal Company installed an 18-foot fan and notes that other fans of various sizes were installed in that fiscal year. In the six years ending 1893, fan installations in Illinois increased from 176 to 286. Another period of increased fan installation began 10 years later with the opening of the Franklin County coal field. With the exception of the 30-foot fan previously mentioned, there was no decided difference in the general sizes of fans installed, those in this most recently developed coal field ranging from 12 to 18 feet in diameter.

There has been much progress made in the design of fans. Available fan efficiency is far greater than has been generally realized. While the cost to change fans is considerable, it would pay the management of each mine to give greater consideration to the constant cost of fan operation for the full 24 hours per day, every day year after year, determining whether or not the cost of changing fans would be warranted.

In recent years there has been a decided change from steam to electricity as the drive for fans. While steam had a definite cost, this cost was not as evident as that for electric power, the latter being measured, paid for to some one else, and the cost definitely known. It is now realized more fully that a fan is a great consumer of energy, being the largest, if operated the entire 24 hours, of any other device in or at the mine. With this knowledge, made more startling because of the direct purchase of the power, there should be greater incentive to get the highest possible efficiency from fan operation.

The mine, in so far as ventilation is concerned, has a rather definite set of characteristics. The height of coal and other natural conditions are apt to remain nearly constant. The mine deisgn including the number of passageways for air travel will probably remain constant. It is probable that no natural or artificial condition will arise to materially change the resistance, other than increased distances for the air to travel as the mine expands, presuming, of course, that air passages will be kept in average opened condition.

As with any combination of work to be done and the mechanism to do the work, the greatest job is to build into the mechanism the characteristics best fitted to do that work. This is true with automobiles, airplanes, and whatnot. With a fan this, of course, is the job for the designer of the fan. As stated before, the fan and its characteristics are most elusive. However, they are subject to natural laws, the recent improved efficiency being nothing more than the result of a better understanding of those laws.

The fan designer needs to know the volume desired and the resulting pressure. He may ask if the mine will change rapidly in these requirements. Knowing the pressure and volume required, he can at once determine the energy in the air.

Efficiently operated fans are like itomobiles or any other mechanical evice in having an approach to corct balance between power input id work accomplished. An automole designed to travel at 5 miles per our and 80 miles per hour is inefficent as to the power input and work ccomplished at such great variation. n automobile having an engine that erates the most efficiently at 40 iles per hour can be run with a fair egree of efficiency at a constant eed of 50 or 30 miles per hour, but either 60 or 20 miles per hour is be the constant speed, then it ould be advisable to install the corect engine for that speed.

Similarly the correct size engine r motor can be installed, depending pon the work to be done by the fan. ut, and here is where there is often onfusion of ideas, any individual fan just as efficient for the mine it entilates irrespective of its speed. he highest efficiency of the fan depends upon two fundamental princiles: First, the inherent qualities of he fan for efficient performance; nd, second, how well the characterstics of the fan fit the characteristics f the mine.

It is not the purpose here to enter nto a discussion of the theory of fan esign. This is a problem for the fan ngineer. It is the purpose, however, o call attention to the general apahetic attitude of the coal industry owards efficient fan performance. he chief faults are:

(1) The original attempt to obtain a fan to fit the mine was without full or correct knowledge of air volume and pressure data, resulting in a fan that was a misfit, usually having the wrong idea that a larger fan is required as the mine develops.

(2) The mine resistance has increased due to expansion to such extent that the fan is inefficient for the present mine, and will further decrease in efficiency as the mine continues to expand.

(3) Selecting a large expensive fan to operate efficiently during the temporary unstable period of a new mine rather than selecting a small inexpensive fan, the proper unit, to operate over the greater life of the mine when the operating requirements of the mine become more stabilized and the work to be done on the air becomes great. If a machine cannot be efficient all of the time, it is obviously preferable that the machine is allowed to be inefficient during the period that there is little work to be done rather than at that period when the amount of work to be done is great.

(4) Old fashioned plain bearings are in too prevalent use. There is not the same consideration given to this factor as in the case of other equipment.

(5) There is frequent loss of power between the motor and the fan. Constant speed motors stop loss of power in rheostats, short pulley centers and V belts lessen wind resistance and slippage losses.

As an example of the foregoing, a fan 16 feet by 5 feet, typical of the fans in general use in the southern Illinois coal field, in use at Mine No. 8 of the Old Ben Coal Corporation, was discarded in October, 1932, and a fan 8 feet by 4½ inches was placed in its stead. The comparative data follows:

	16′ x 5′ fan	8′ x 4½′ fan
Blades.......	Forward curve	Backward curve
Speed........	123 r. p. m.	318 r. p. m.
Volume......	113,856 cu. ft. per min.	117,300 cu. f. per min.
Static Pressure...	3.56 in. of water	3.60 in. of water
Overall unit efficiency....	40.3%	78.1%

This change has resulted in a monthly saving of $552 in electric power cost.

The complete cost of this change, exclusive of motor and automatic starter, was $5,785.11. This cost divided by $552 (savings per month) equals 10⅓, which is the number of months that the saving in cost will pay for the complete installation. On the other hand, it takes considerable thought to scrap a $27,500 fan and drive installation.

When one considers that such a monthly cost has been paid for many years, all because of not having the proper ventilating unit installed, it is time to profit by that experience and prevent, if possible, recurrences.

Fan engineers agree that the fan with backward curved blades will prove more successful when applied to mine ventilation than the fan with forward curved blades. There are two principal reasons: First, a properly designed backward curve fan can be made to develop a higher mechanical efficiency than a properly designed forward curve fan; second, the backward curve fan is a more stable ventilating unit in that it will maintain its high efficiency over a wider range of varying underground mine conditions than a forward curve fan. The forward curve fan for a particular job will be smaller than a backward curve fan for the same job, due to the fact that the volumetric capacity of the forward type is higher than the backward type. However, the slight difference in initial cost is greatly outweighed by the higher operating mechanical efficiency of the backward curve fan. It must be borne in mind that it is mechanical efficiency that determines cost of operation and not volumetric capacity or manometric efficiency. The reason for this difference in mechanical efficiency in the two types of fan is that the backward curve fan, by virtue of its larger wheel volume, passes air through itself at a lower absolute velocity than does the smaller forward curve wheel. In both cases the total work done on the air manifests itself, almost completely, in the form of pressure energy as the air leaves the fan outlet. Since each fan must store in the air the same amount of total energy in order to overcome the mine resistance, it is obvious that it is necessary for the forward curve fan to perform a greater amount of conversion of kinetic energy to pressure energy than the backward curve fan. A student of aerodynamics is well

Mine	Daily tonnage	Present fan size	Proper fan size	Times too large	Present fan-motor input kw.	Possible percentage power reduction	Possible saving per year at 1½ cents per kw. h.	Approximate cost of new fan	Percent return in investment per year
A	6,000	16′ x5′	7.5′x3.75′	6.05	130.00	36.0	6,270.00	6,320.00	99.25
B	7,000	16 x5	9 x4.5	3.50	123.00	22.0	4,130.00	8,550.00	48.30
C	4,500	12 x5	7.5 x3.75	3.42	112.00	27.5	4,700.00	6,350.00	74.00
D	10,000	12 x5	9.5 x4.75	1.68	233.00	16.5	5,850.00	9,850.00	59.50
E	4,000	16 x5	6.5 x3.25	9.25	118.50	48.5	8,770.00	4,525.00	194.00
F	4,000	16 x6	7.5 x3.75	6.05	59.10	33.3	3,000.00	7,770.00	38.10
G	4,500	16 x5	9 x4.5	3.50	64.80	32.2	3,190.00	8,800.00	36.30
H	4,200	16 x5	9 x4.5	3.50	270.00	27.5	11,320.00	8,800.00	129.00
I	4,000	16.5 x8	7 x3.5	12.60	157.00	53.5	12,800.00	4,900.00	261.00
J	7,000	14 x5	9 x4.5	2.70	149.00	44.2	9,770.00	8,310.00	117.50
K	3,000	12 x4	5.5 x2.75	6.90	60.00	71.0	6,500.00	3,270.00	199.00
L	2,500	15 x5	6.5 x3.25	8.20	26.20	73.0	2,920.00	4,510.00	64.70
M	3,500	12 x4	7.5 x3.75	2.70	60.40	51.5	4,750.00	6,350.00	74.50
N	4,000	10 x5	8 x4	1.96	68.70	49.0	5,140.00	8,300.00	62.20
O	1,500	14.5x5.84	3.5 x1.75	57.20	54.00	69.0	5,680.00	1,620.00	350.00
Avg.				8.60	.....	43.5	....	....	120.00

vare of the fundamental fact that fluid in motion, be it liquid or gas- ous, when subjected to expansion ndergoes the loss of a part of its nergy due to "shock," which lost nergy can not be recovered. It is, nerefore, a corollary that the fan nat has the least amount of this onversion to do can be made the ost efficient fan, which is why the ackward curve fan is the more effi- ent type.

The foregoing experience is typical f a few of the leading mines in the oal fields of the nation. To further ustrate the lack of application in eeping abreast with up-to-date fan science, the following tabulations are given for otherwise modernized coal fields, the data in part being collected by the writer:

Experience has taught us that although a fan is new and of modern design and operates efficiently at a mine of certain size, it is very improbable that this fan will operate efficiently at another mine. Rarely do two mines have identically the same ventilating characteristics.

As previously stated, it cannot be emphasized too strongly that the fan is usually the most wasteful consumer of power in or about a coal mine.

BUDGET CONTROL OF OPERATIONS

By G. G. CROWDER
Assistant to Vice President in Charge of Accounting
Peabody Coal Company

In discussing budgets in the mining dustry, we find two schools, one us- g gross money or man-hours, and e other a unit or per ton basis. The oss money or man-hour quota basis still in use in more companies at e present time. The per ton bud- et is an outgrowth of the former and ercomes or controls the variable of oduction, and to that extent is perior, and in addition can be made e of by finance and sales depart- ents in addition to the operating d engineering departments. Inas- uch as everyone is familiar with the an-hour quota basis, we will con- ne our discussion to the working of e per ton method.

Budgets in practical use are de- sed to forecast results and eliminate le-of-thumb practices. To be en- rely successful and satisfactory they ould be made so they can be used all departments of a company. his is quite important and results in smooth-working organization.

Budgets correctly prepared are used as follows:

First. By the sales department to sell with confidence varying tonnages, knowing exactly the cost of additional tonnage to give any mine more or full working time. The financial department at that time, knowing the factors of costs and selling prices in effect, can forecast immediately the resulting profit or loss.

Second. By the operating department to control their organization and obtain results expected from each mine as well as subdivisions of that mine on any day of the month.

Third. By the accounting department as a basis of this cost accounting as well as their general accounting system, thereby eliminating dual control and extra effort and expense which exists when a man-hour quota basis is in effect.

When using the man-hour quota basis, it is difficult to prepare and present in advance of operations sufficient concrete data to permit the sales and financial departments to lay their programs for 3, 6, or 12 months in advance. The proper per ton basis makes it possible to prepare a concise statement of each mine, showing production and cost per ton for any number of working days in a month. For illustration, we present the following anticipated cost for a mine:

Days Worked	Production	Labor and Supply Cost Per Ton	Fixed Charges Per Ton	Total Cost Per Ton
6	27,600	$1.3384	$0.4069	$1.7453
8	36,800	1.2021	.3379	1.5400
10	46,000	1.1200	.2977	1.4155
12	55,200	1.0653	.2664	1.3317
14	64,400	1.0263	.2474	1.2737
16	73,600	.9956	.2306	1.2262
18	82,800	.9742	.2170	1.1912
20	92,000	.9560	.2050	1.1617
22	101,000	.9410	.1960	1.1370
24	110,400	.9293	.1873	1.1166
26	119,600	.9184	.1797	1.0981

This form is quite condensed and has a two-day spread in working days. The labor and supply cost per ton includes all cost at the mine for which a superintendent is responsible. The fixed charges include taxes, insurance, depreciation, depletion, compensation insurance, and proportionate division office expenses.

This statement for those who work better with graphs results in a hyperbolic curve from which can be read each day of working time as well as fractions. (Exhibit No. 1.)

Now, what does this do for the sales department?

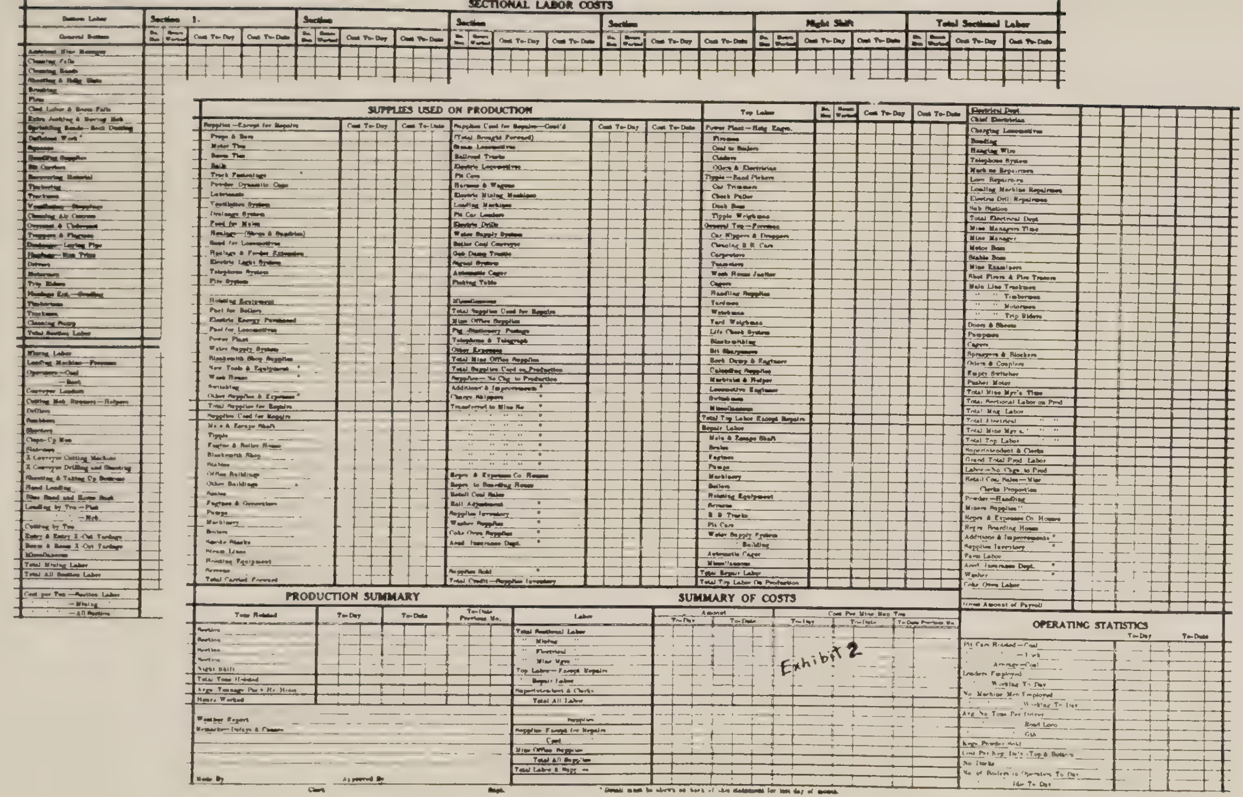
1. It shows the breaking point between profit or loss for each mine. You will note the point where the average selling price line cuts the total cost curve shows the number of days and tonnage needed to break even.

2. It shows them also the exact cost of any additional tonnage they might desire to sell over and above any certain tonnage then being produced, at a glance. For illustration, say a mine was working 14 days a month at a cost of $1.2737 and they had 30,000 tons in view at a price. The cost of this additional coal would not be $1.2737, but the difference between 94,000 tons at $1.1617 per ton and 64,400 tons at $1.2737, or $.9180 per ton.

3. This chart enables the sales and financial departments to plan in advance what mines to work and how many days for each one. Mines not only have high and low operating labor and supply costs but high and low idle day and supply costs as well as fixed charges. A scientific study of allotment of tonnage sold can be worked out without further effort than the application of this condensed per ton budget. This is the real test and results in a much better condition of a company as a whole.

These uses and others by the sales and financial departments can be had without causing the operating or accounting departments further effort once the budgets are prepared in this manner.

The operating department, as stated, uses this budget to control their organization and get the results they wish. It enables them to know on any date of a month with a given number of working days the cost they should have. For example, on the 20th of the month with 9 working days, it is equivalent to 12 days on a monthly basis, so the mine superintendent should have a labor and supply cost of $1.0653. This can be car-


SECTIONAL LABOR COSTS
Section 1.
Section
Section
Section
Night Shift
Total Sectional Labor
Cost To-Day
Cost To-Date
SUPPLIES USED ON PRODUCTION
Top Labor
PRODUCTION SUMMARY
SUMMARY OF COSTS
OPERATING STATISTICS
Exhibit 2

Reports used by Peabody Coal Company

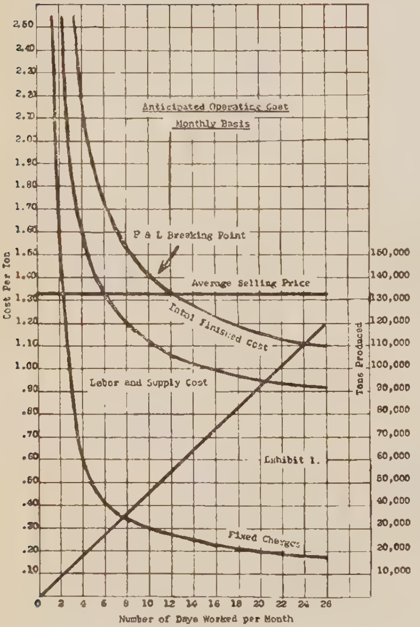


Exhibit No. 1

ried further by breaking the total mine cost down into departments and sections so each foreman will know how he stands as well as the superintendent for his mine as a whole. The budget is made by the engineering and planning divisions from about a three-month experience to arrive at an average working day, idle day, and Sunday. It is changed each time there is a change in wage scales or general physical condition of the mine. Sufficient margin must be allowed for keeping the mine in approved working condition and frequent examinations, of course, made to see to this point. The main advantage of this per ton method is that it permits the superintendent to know exactly where he stands at any time during the month, and by knowing that he can plan and do his advance work as he has margin to do it on a systematic basis. It has been very interesting to notice the general condition of properties improve where this system has been put into effect. There are numerous hurdles along the way to prevent bad practices developing and continuing to the detriment of the property. Time does not permit of further explanation about the many steps of preparing this working per ton budget and the benefits to be derived by operating departments.

This particular method of budgeting was developed through the joint efforts of the operating and accounting departments, as all should be prepared. There is absolutely no overlapping or duplication anywhere in it, and the daily cost made daily is an integral part of the general accounting practice. The cost statement, a reduced Exhibit No. 2, definitely controls all labor and equals the total pay roll, as well as all supplies. This, of course, takes in non-operating as well as operating charges.

One important diversion has been made (as will be noticed) in that all labor has been broken down into lines of control rather than departments of cost, like haulage, drainage, etc. For example, each section foreman's cost is subdivided to give his cost of coal to the parting, including the mining cost whether it be piecework or mechanical loading. The electrician, mine manager, top boss also have sections on which costs are computed. There is a distinct advantage in this in that it shows the cost of each boss' department. It is quite simple to obtain the haulage, ventilation, drainage, mining machine repair, lubrication, and other costs if desired. The expense for both labor and supplies is accumulated daily and to date for a month by all these subdivisions for further comparative purposes.

Under this plan no foreman is al-

ASS'T. MINE MANAGER'S DAILY TIME SHEET

Section ____________

Mine No ____________

Loading Machine No. ____________

DISTRIBUTION

						General Section																Ventilation					Haulage				Haulage Extension				Loading Machines—Mining																				
	Check Number	Name	Hours Worked	Rate Per Day	Extension	Asst. Mine Mgr.	Cleaning Falls	Cleaning Roads	Bracing & Bldg. Stps.	Brushing	Fires	Coal Loading & Long Falls	Erec. Jacking & Moving Brattice	Sprinkling Roads	Deficient Work	Squeeze	Handling Supplies	Bit Carriers	Recov. Material	Timbering	Trackmen	Stoppings	Cleaning Air Cour.	Over & Under Cast	Trappers & Flaggers	Laying Pipe	Man Trips	Drivers	Motormen	Trip Riders	Grading	Timbermen	Trackmen	Cleaning Sump	Load Mch. Foremen	Operators—Coal	Operators—Rock	Conveyor Loaders	Cutting Machine Runners Hlp.	Drillers	Snubbers	Shooters	Clean-up Men	Slatemen	Others	Repairmen	Shooting & Taking up Bottom	Hand Loading	Miscellaneous	Hand Fixing					
Loading Machines																																																							
Delays and Causes																																																							

Form No

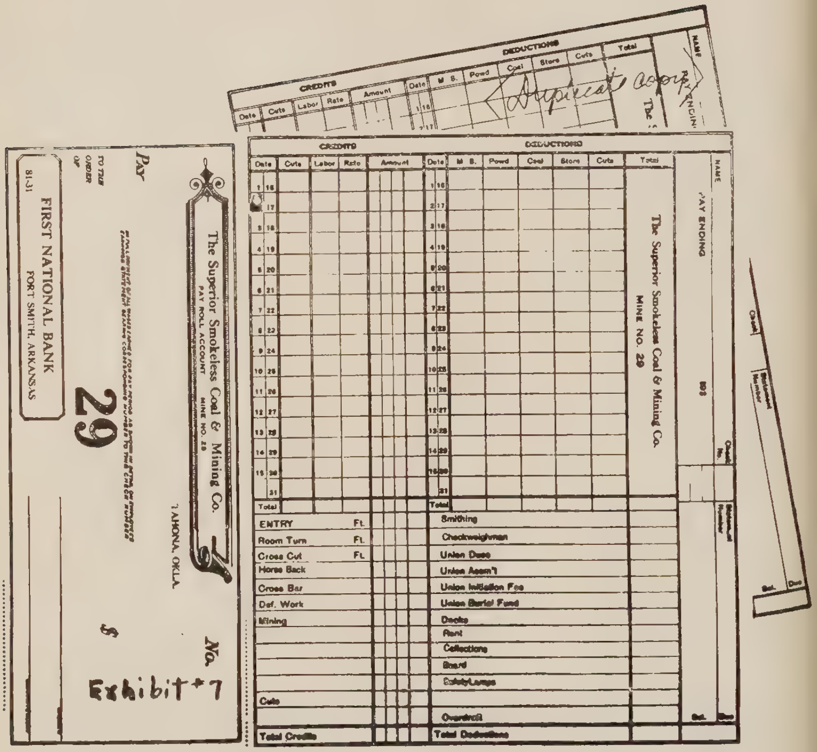
TOP FOREMAN'S DAILY TIME SHEET

Date ____________ 19____

Mine No. ____________

DISTRIBUTION

					Power Plant					Tipple					General Top																				Repairs														Labor No Cost to Coal				
	NAME	Hours W'k'd	Rate per day	Extension	Engineers	Firemen	Coal to Boilers	Cinders	Oilers & Elect.	Band Pickers	Car Trimmers	Check Puller	Dock Boss	Tipple Wighm.	Top Foreman	Nipp's & D'pp's	Clean. R. R. Cars	Carpenters	Teamsters	W. H. Janitor	Lagers	Hdlg. Supplies	Yardmen	Watchmen	Yard Wighm.	Life C. K. Syst.	Blacksmithing	Bit Sharpeners	Rock Dump & Lag.	Unload'g Supplies	Mech. & Helper	Loco. Engineer	Switchmen	Miscellaneous	Repr. to Shaft	" " Scales	" " Engines	" " Pumps	" " Machin'y	" " Boilers	" " Hoisting Equipment	" " Screens	" " R. R. Tr.	" " Pit Cars	" " Water Sup. System	" " Building	" " Automatic Cages	Miscellaneous		Powder	Rep. Co. House	Charge to *	A. and I. *



Duplicate copy

The Superior Smokeless Coal & Mining Co.
PAY ROLL ACCOUNT MINE NO. 29
TAHONA, OKLA.
No.
Pay
TO THE ORDER OF
29
$
FIRST NATIONAL BANK
FORT SMITH, ARKANSAS
81-31
Exhibit #7

The Superior Smokeless Coal & Mining Co.
MINE NO. 29
NAME
PAY ENDING

CREDITS: Date, Cuts, Labor, Rate, Amount
DEDUCTIONS: Date, M. S., Powd, Coal, Store, Cuts, Total

Total
ENTRY Ft.
Room Turn Ft.
Cross Cut Ft.
Horse Back
Cross Bar
Def. Work
Mining
Cuts
Total Credits

Smithing
Checkweighman
Union Dues
Union Assm't
Union Initiation Fee
Union Burial Fund
Docks
Rent
Collections
Board
Safety Lamps
Overdraft
Total Deductions

Bal. Due

lowed to carry a semimonthly time book and no timekeepers are needed. The bosses write off a time sheet each day. This is printed up to simplify his work and keep distribution uniform. Captions are in line on the same as on the cost statement. A perfect balance between pay roll and cost distribution is obtained in an easy manner. Time sheets are posted direct to a duplicate pay statement. Exhibit 7, thereby eliminating all pay forms and reducing pay-roll department's time by the time used to prepare statements.

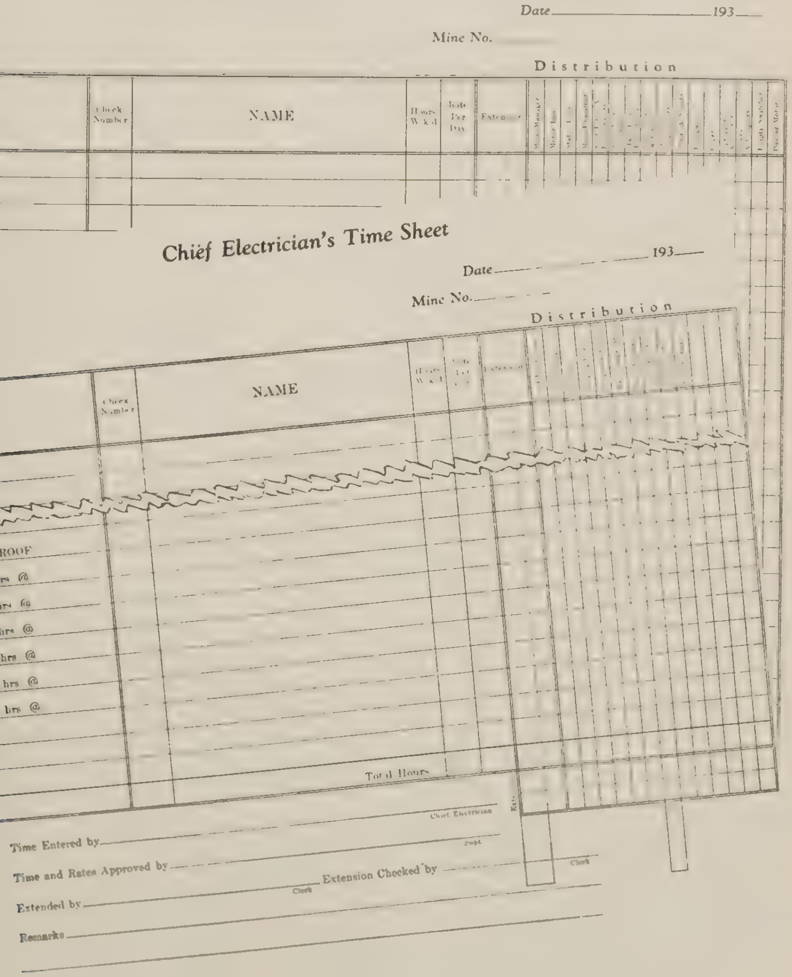
Supplies should be as closely watched and budgeted as labor. They should be charged into cost as used. This makes it necessary to accurately account for them as received and used. This results in inventory records which permit of further studies in minimum and maximum quantities to be kept on hand. Supplies should be arranged to permit frequent checking to prevent inventory shortages which disturb the budget. This can be accomplished by arranging supplies in the bins or shelves in exactly the same order as the inventory records are kept. Space should be allotted each item so it will have a space at the front of the bin at which point a small identification card should be tacked. If the supplies are neatly arranged so they can be counted with the eye, then whole departments can be counted and

cked in a half hour and inven-
y variations will disappear and
se to be a disturbing element in
lgeting.

his all necessitates a very close
king arrangement between the ac-
nting and operating departments,
if properly worked out the main
ounting office can dispose of all expense ledgers and use the records compiled at the mines for cost purposes, for their financial records at the end of the month. Needless to say, by doing this general books can be closed 5 to 10 days earlier, which is a further advantage to the financial heads of the company.

Another distinct advantage in mak-

Mine Manager's Daily Time Sheet



Date 193

Mine No.

Distribution

Check Number	NAME	Hours Worked	Rate Per Day	Extension

Chief Electrician's Time Sheet

Date 193

Mine No.

Distribution

Check Number	NAME	Hours Worked	Rate Per Day	Extension

ROOF

rs @

rs @

hrs @

hrs @

hrs @

hrs @

Total Hours

Chief Electrician

Time Entered by

Supt.

Time and Rates Approved by

Extension Checked by

Clerk

Extended by

Clerk

Remarks

ing use of the daily cost records prepared at the mines for the financial reports, it eliminates friction and misunderstanding between departments, for there is no change between the mines and the finished reports as far as labor and supplies are concerned.

This is no experiment. It has been in use 12 years in principle. Refinements are added as merited. Not long ago, the loading-machine manufacturers gave us the idea of figuring the cost of coal to the parting, which resulted in putting the mining cost into a sectional split-up under each boss. It has resulted in some savings in closer supervision of the mining or "face" cost.

The accounting firm who installs this system have applied the same principle to foundries, machine shops, retail coal yards, and numerous other forms of manufacture. It has been very satisfactory to us.

ADVANTAGES AND USE OF DEDUSTED COAL AND ITS PRODUCTS

By HENRY F. HEBLEY
Allen & Garcia Company
Chicago, Ill.

n Europe the removal of dust from
l was a practice brought about to
rove the art of coal cleaning.
erican development however, grew
m the demand for a special fuel,
ch would be more suitable for use
small automatic stokers.

Vhen attempting to burn slack coal
domestic stokers, which are auto-
ically controlled, either from the
m pressure line or the room tem-
ature, it often occurs that the
ker is not in operation for a con-
erable period of time. During this
rval, the fuel bed is prone to form
rust on the top, and on the re-
nption of the coal feed and the
supply, the crust forms an im-
vious crown on top of the fuel
l, causing a ring of "forge fire"
the furnace, with its attendant
ess air and poor efficiency. To
igate this objection, minus 5/16"
l was treated in aspirators to re-
ve the minus 48 mesh material.
s procedure, especially when ap-
ed to free burning coals of the
dwest coal fields, tended to keep
fuel bed more porous. giving an
n distribution of air. It is a char-
eristic of Illinois coals that the
content increases with decreasing
e; and as the ash is low in fusion
nt, the removal of the dust reduces
clinkering tendencies, and be-
use of the absence of very fine
t, a minimum of material is lifted
o the tubes, or flues, of the boiler.
art from this freedom from oper-
ng annoyances, an eight day test
mparing minus 2" screenings and
lusted coal, showed a 5% increase
in evaporation per pound of coal, in favor of the dust free coal.

When cleaning coal the possible advantages accruing from the removal of the dust prior to cleaning should be given consideration.

Improvement in Efficiency of Cleaning.

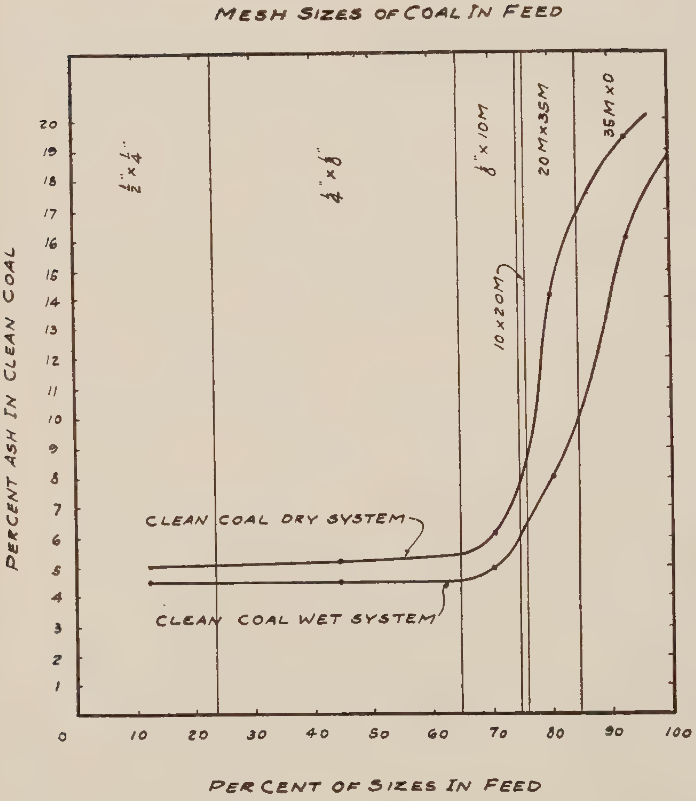
It is well known that the efficiency of coal cleaning equipment depending on the difference in specific gravity, both wet and dry, becomes less, as the size of the coal treated decreases. In this regard, the wet systems generally maintain their efficiencies to a smaller size than dry cleaning equipment, but with few exceptions. any improvement in cleaning accomplished on coal below 60 mesh, is negligible.

To illustrate this condition, Curve No. 1, based on data given by Mott has been drawn. Two samples of minus 1/2" coal, from the same mine and seam, were subjected to cleaning. One sample was washed in a wet system and the other was treated on a dry table. It will be noted that the wet system cleaned to 4.5% (inherent ash, 3%) down to 10 mesh, after which the ash content rose rapidly as the size decreased.

Similarly, the dry cleaning system cleaned to 5% but began to lose in efficiency below 1/8" in size. The removal of the fine sizes would have eliminated that portion of the coal which received scant improvement.

Improvement in Drainage of Washed Coal.

After coal has been washed the dewatering of the product must be as

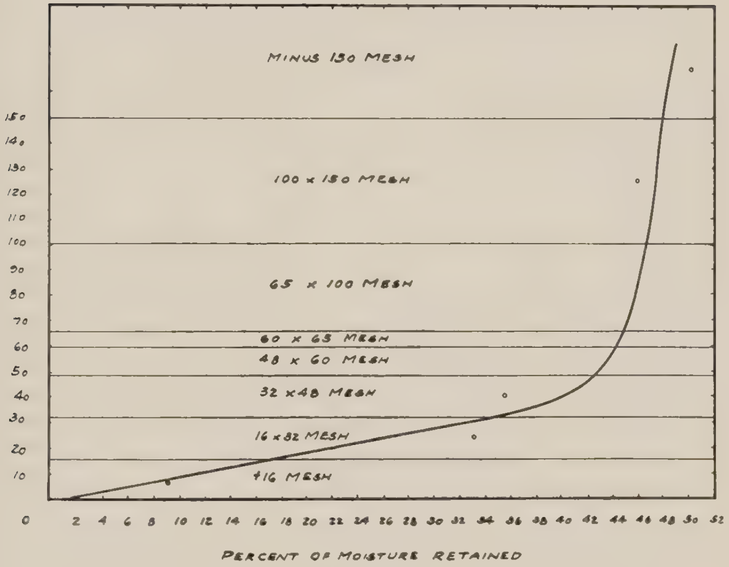


CURVES SHOWING DECREASE IN CLEANING EFFICIENCY
WITH
DECREASING SIZES

Curve No. 1

efficient and rapid as possible. Sized coal above 1/2″ leaving the wet sizing shaking screens, are little troubled with high moisture content as the voids are large and the ratio of surface to volume of individual coal pieces is small. However, the drainage of fine coal presents many difficulties.

Due to the large surface of the fine coal and the closeness with which adjacent pieces can be packed, capillarity in the coal mass makes gravity drainage practically useless. Also, due to the porous structure of Fusain, any considerable percentage in the fine sizes will effectually hold to moisture.



CURVE SHOWING DECREASE IN DRAINAGE
WITH
DECREASING SIZES
Curve No. 2

Curve No. 2 shows the moisture ained in various sizes, after the l sample had been subjected to vity drainage for 24 hours. Thus, coal below 48 mesh in size will w practically no reduction in mois- e content. Other systems of de- tering are available such as high ed screens, centrifuges, suction ers, and heat dryers; but these are pensive both in investment and intenance. Should there be soft le or clay present, which disin- rates quickly when in contact h water, the drainage problem in- ases in difficulty.

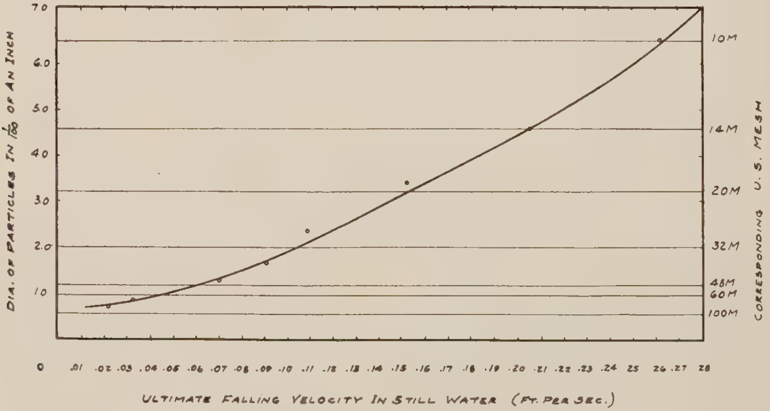
Dedusting the coal prior to coal aning would have the advantage removing the troublesome fraction the feed and facilitate drainage. e characteristics of the coal may be such that the dust removed may be low in ash content. If such is the case, the dry dust can be remixed with the cleaned fine sizes, increasing the yield and decreasing the moisture content.

In the wet washing of coal, the appearance of the finished product is of importance. If the coal is dull and coated with fine particles of coal dust deposited by the washery water, it gives the impression of being dirty notwithstanding the fact that it conforms to the ash requirements. Rinsing sprays are used to overcome this objection, but unless generous quantities of clean spray water are used, the coal will continue to be lustreless. The elimination of the dust, however, leaves the coal brighter, as it leaves the dewatering screens and reduces the quantity of "make up" water required.

Improvement in the Clarification of Washery Water.

In washeries where the water supply is restricted, or where the State Law forbids the discharge of contaminated water to creeks or rivers, it is necessary to install water clarification equipment. Where extremely fine sizes are present, and especially if clay or shale particles are in suspension, clarification becomes difficult.

To illustrate this condition, Curve No. 3, based on data from Needham has been plotted. It will be seen that below 60 mesh, the falling velocity is very small, even in still water. If any agitation of the water in the settling tank is experienced, the clarification is still further retarded. Due to the discharge of dirty water from the washery into the tank, there is always some disturbance and velocity present. The elimination of the fine dust before treatment, therefore reduces the water clarification problem, as the larger particles settle faster. The specific gravity of the wash water may then be kept more constant, and the washery results will be more uniform.



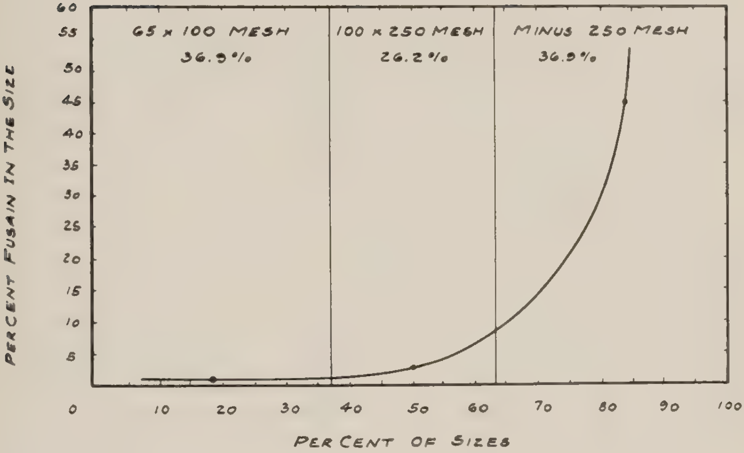
CURVE SHOWING DECREASE IN CLARIFICATION OF WATER
WITH
DECREASING SIZES

Curve No. 3

Control of the Fusain in Coking Coal:

Until recently, it was thought that fusain (mother coal, or mineral charcoal) was a detriment to the manufacture of coke. It was distinctly non-coking, and tended to form a large percentage of coke breeze. However, the work of Wheeler and Mott has shown that fusain properly controlled may be mixed with coal of a coking nature and the resulting coke will be quite satisfactory and in some cases improved.

As fusain is for the most part extremely friable, it is often found concentrated in the fine sizes. Curve No. 4, based on data given by the same authorities (Wheeler and Mott) shows clearly the rapid increase of the fusain percentage as the sizes de-



¼" x 0" COKING SLACK

¼" x 65 MESH	81.3%
65 MESH x 0	18.7%
TOTAL	100.0%

CURVE SHOWING INCREASE OF FUSAIN CONTENT
WITH
DECREASING SIZES
Curve No. 4

crease. With coal of this nature, the removal of the fine dust and the remixing of it in the correct proportion will allow the coking mixture to be controlled. If mixed with washed coal the reduced moisture content thus brought about will enable an increased coke oven output to be obtained.

Use of the Products of De-dusting.

The foregoing description has dealt chiefly with the advantages to be derived from dedusting raw coal prior to delivering it to coal cleaning apparatus. However, with the exception of coals whose extracted dust is low in ash, and can be mixed back with the washed product, there is a definite problem to be solved in the disposal of the extracted dust.

In contemplated plants where no coal cleaning equipment is to be installed, and the dedusted coal is to be prepared for domestic stoker use, the inability to find a market for the dust deters the operator from making the necessary installation. There are, however, various potential outlets for this by-product which will bear some consideration. When considering the uses of coal dust, the following outlets come to one's mind:

(1) Briquetting of the dust.
(2) Transporting the dust in cars to pulverized fuel power plants.
(3) Colloidal fuel.

(4) Low temperature carbonization of the dust.

(5) Burning the dust in furnaces without further grinding.

It is realized that in all these matters the question of economics is the ultimate governing factor, and each problem should be weighed on its merits.

Briquetting:

This method of disposing dust has been in use for many years, notably in Germany, Great Britain, Belgium and France. The briquetting of brown coal (lignite) in Germany has developed into a huge industry. This particular material fortunately does not need the addition of a binder. With bituminous coal, however, a binder is needed. This material consists either of coal tar pitch or asphalt, although, many other substances ranging from wood pulp sulphite stock to molasses have been tested and in some cases adopted. A coal tar pitch having a softening point between 140 degrees F. and 170 degrees F. gives satisfactory results.

In the manufacture of briquettes, a high proportion of fine dust will require a large amount of binder. The amount required varies from 6% for high volatile coals with small quantities of dust, to 10% for low volatile coals with heavy dust concentrations. Moisture content in coals to be briquetted should not be over 5%, and the ash content should be kept low, as it wastes the binder.

Generally, the cost of the pitch is the main item of expense, consequently the smallest amount consistent with the quality of the briquette should be used. Since so much has been published on the manufacture of briquettes, further study can be made by referring to the various publications dealing with this subject.

Pulverized Fuel Plants:

The burning of coal in pulverized form can be accomplished quite satisfactorily when the feed to the pulverizing mills is composed of dust collected from dedusting apparatus. In a test run on such material, it was found that the mills had no difficulty in grinding it, but trouble was experienced in unloading the coal dust from the car. However, there are available several designs of tank cars which have been developed for the efficient handling of finely powdered materials.

Colloidal Fuel:

Recently there has been renewed interest in the manufacture and use of coal-oil mixtures wherein finely ground coal dust is mixed with fuel oil, and a small proportion of lime rosin "soap" acting as a stabilizer. This mixture is used as a substitute for liquid fuel. It has the advantage of being able to be burned with a minimum of excess air and due to the presence of solids in the flame, a more intensely radiating flame is obtained. For a given volume, colloidal fuel contains a greater number of heat units than either coal or oil.

Due to the specific heat of the mixture being approximately 26% less than fuel oil, less heat is required for heating the fuel prior to

Test No.	2	4	6	12
Time in hours	2	2.25	0.66	3.17
Pressure on fuel in lbs. per sq. in.	131.8	149.5	156.5	101.0
Boiler Eff. in %	65.5	70.7	91.5	84.2

being fed to the burners. The following tests on the boilers of the U. S. S. Gem, burning colloidal fuel, consisting of—

30% coal
70% fuel oil
1% lime rosin stabilizer, were given by S. E. Sheppard.

Referring to the ability of the solids in the mixture to stay in suspension over a period of time, the following figures by L. W. Bates are of interest.

Mixture	Settling Period	% Solids Settling	Use	Authority
31% Poca. coal 69% Navy fuel oil Stabilizer	6 Months	Trace	Marine Boilers.	Bates
38% Coal & coke 62% Mexican fuel oil Stabilizer	5 Months	2.6	Marine Boilers.	Bates
40% Coal 60% fuel oil	9 Months	Trace	Marine Boilers.	Bates

Tests have also been carried out by burning this type of fuel in the fire boxes of oil burning locomotives and the results were quite satisfactory.

Low Temperature Carbonization:

An enormous amount of research on low temperature carbonization of coal has been carried out during the past decade and is continuing. Many varieties of equipment have been constructed and tested. One of these, which shows promise, and which is directly applicable to the manufacture of domestic smokeless fuel from coal dust, is the C. T. G. (Chemisch-Technische Gesellschaft) system. It has the advantage of being able to coke aspirated dust 1/25″ by 0″ extracted from coal in dedusting units. It is claimed that excellent coke was obtained from a low grade dust containing 13.1% ash. A full description of this machine is given in the Proceedings of the Second International Conference on Bituminous coal, Vol. 1.

Production of Water Gas From PowerFuels:

It is well known that passing steam over heated carbon will form water-gas, a gas very rich in hydrogen. The demand for hydrogen for various chemical and industrial processes has increased greatly in recent years, and as the water-gas method of hydrogen production is one of the cheapest, it is well worth consideration.

Normally the manufacture of water-gas is intermittent, there being alternately "blowing" and "steaming" periods.

With the Heller process, which has been installed in a semi-commercial way at the Berlin Gas Works in Germany, pulverized coal is sprayed into a cylindrical retort, where the fine coal dust comes into intimate contact with jets of superheated steam. The process is continuous in operation and provides another possible outlet for some of the dust at coal mines.

Combustion of Coal Dust Without Further Grinding:

There is another very promising field where the coal dust from dedusting equipment can be used without further preparation. It consists of burning the coal dust in the normal pulverized furnaces, modified to handle the raw coal dust. Over twenty installations have been put in at various Germany mines where dedusting or aspirating apparatus has been installed as part of the coal preparation equipment.

Most of the coal burning installations are giving very good results even though some are handling dust whose maximum size pieces are from .078 to 0.157 inches in diameter. Most of the furnaces are similar to the ordinary pulverized coal units, with the exception that inclined porous refractory grates are placed at the bottom of the furnace. The coal is blown into the furnace chamber in the usual manner, and that percentage of the dust which is small enough, burns in suspension while the heavier coal particles settle out of the gas stream and are deposited on the refractory grates.

As these grates are provided with

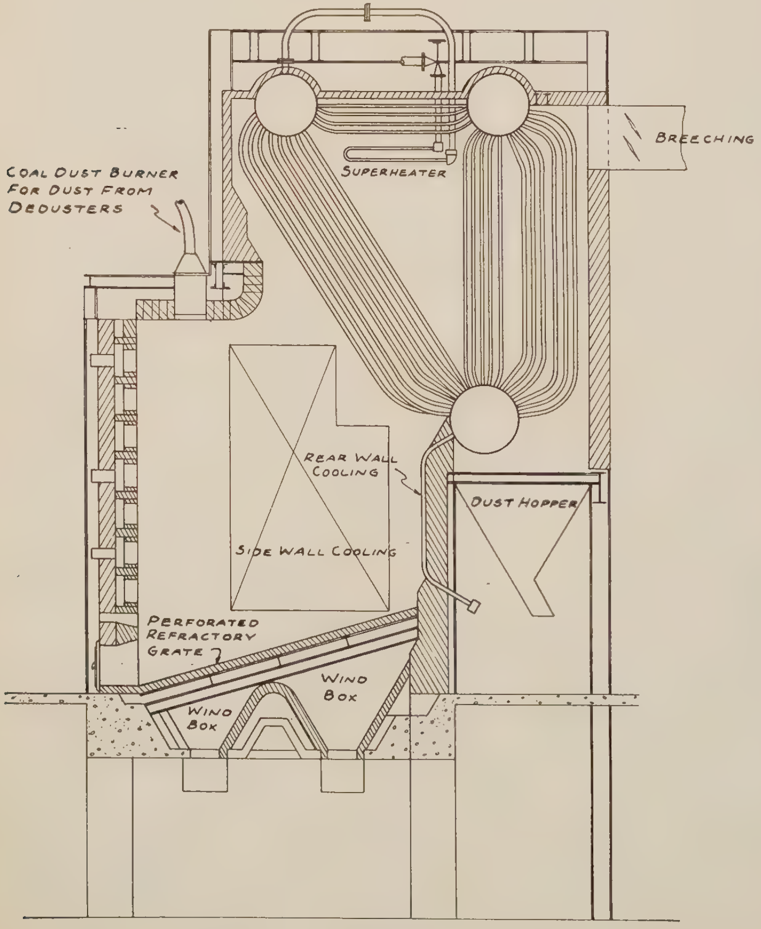
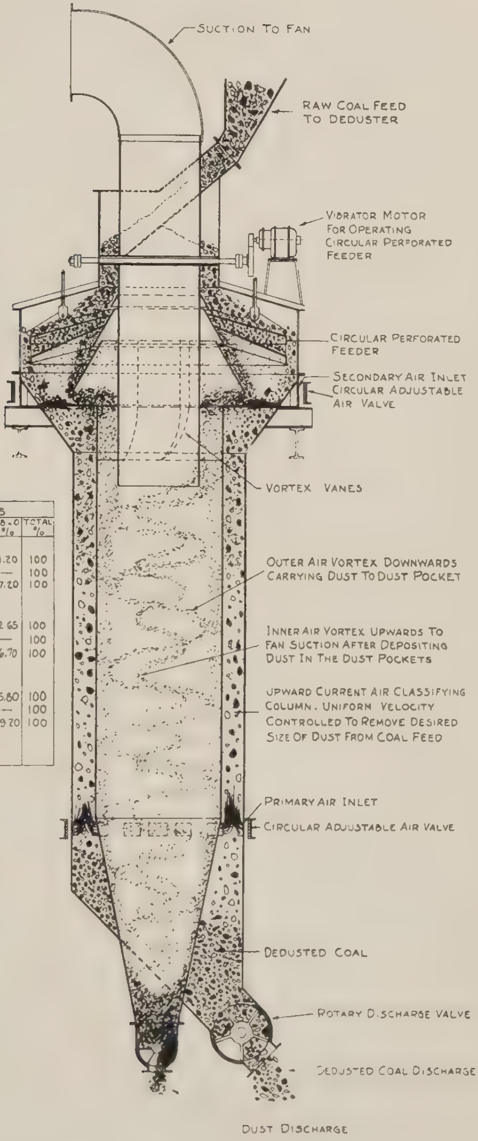


Fig 1


Suction To Fan
Raw Coal Feed To Deduster
Vibrator Motor For Operating Circular Perforated Feeder
Circular Perforated Feeder
Secondary Air Inlet
Circular Adjustable Air Valve
Vortex Vanes
Outer Air Vortex Downwards Carrying Dust To Dust Pocket
Inner Air Vortex Upwards To Fan Suction After Depositing Dust In The Dust Pockets
Upward Current Air Classifying Column. Uniform Velocity Controlled To Remove Desired Size Of Dust From Coal Feed
Primary Air Inlet
Circular Adjustable Air Valve
Dedusted Coal
Rotary Discharge Valve
Dedusted Coal Discharge
Dust Discharge

TYPICAL RESULTS

SEAM	DEDUSTED COAL %	DUST REMOVED %	SCREEN ANALYSES						
			COAL PRODUCT	¾ x 4M %	4 x 14M %	14 x 28M %	28 x 48M %	48 x 0 %	TOTAL %
IND. NO. 3	89.7	10.3	RAW	56.1	24.6	5.24	2.86	11.20	100
			DEDUSTED	69.0	27.4	3.60	—	—	100
			DUST	—	2.20	5.90	14.70	77.20	100
ILL. NO. 6	82.40	17.60	RAW	42.8	28.5	10.7	5.35	12.65	100
			DEDUSTED	44.26	40.06	12.50	3.17	—	100
			DUST	—	—	9.50	23.80	66.70	100
ILL. NO. 5	86.40	13.60	RAW	55.80	28.85	6.25	3.30	5.80	100
			DEDUSTED	57.90	36.10	6.0	—	—	100
			DUST	—	3.20	.070	26.90	59.20	100

Fig. 2

the necessary air inlets, the coal, after being deposited, is supplied with sufficient air to complete the combustion of the coarser particles. The velocity of the air entering through the deck is such that all but the largest particles are lifted off the grate and burned in suspension. Figure 1 shows a cross sectional elevation of a boiler installation which is at present in operation.

The following test results taken from figures given by O. Haller are indicative of the operation that has been attained with some of these installations.

Description	Test No. 1	Test No. 2	Test No. 3	Test No. 4
Coal Burned	Med. Vol.	Low Vol.	Low Vol.	Low Vol.
Prox. Analysis				
Moisture	3.20	2.17	1.69	1.73
Ash	11.60	6.53	8.60	7.17
Vol. Mat.	25.23	11.41	21.05	12.57
Fixed Carbon	59.97	79.89	68.66	78.53
Cal. Value as Received	12460	13750	13540	13748
Screen—				
1/8″ by No. 76	38.38%	55.07%	Dust from Aspirator	Dust from Aspirator
No. 76 by No. 178	55.89%	25.68%		
No. 178 by 0	5.73%	19.25%		
Boiler	884 HP	315 HP.	339 HP.	339 HP.
Steam Pressure	200 lbs.	200 lbs.	170 lbs.	170 lbs.
Furnace Vol.	5060 cu. ft.	3430 cu. ft.	1766 cu. ft.	1766 cu. ft.
Grate Area	248 sq. ft.	....	....	....
Heat Release	12,000	11,300	18.000	18,000
CO-2	13.5	13.3	15.1	16.6
Eff. %,	81.0	80.0	79.93	83.0

ing load for the boilers would be desirous when burning the class of fuel and coal mine steam demands are notoriously fluctuating. This disadvantage, however, can be overcome by modern steam power plant design.

A study of the proximate analyses will indicate that low volatile coals containing as little as 12 per cent have been burned successfully. Coals similar to Pocahontas or New River seams with the volatile matter varying from 16% to 25%, should give no difficulty. As the ash must be kept in its dry state, sufficient furnace volume and water cooled wall area is essential. Figure No. 2 shows a typical dedusting equipment which can be used for the removel of dust from the fines.

The object in submitting these notes has been to draw to the attention of those interested, the many and varied ways in which dedusted coal and its products can be utilized. If that object is in any degree realized, then the paper has served its purpose.

PROCEEDINGS OF ILLINOIS MINING INSTITUTE FORTY-FIRST ANNUAL MEETING

Friday, November 3, 1933

Held at Hotel Abraham Lincoln, Springfield, Illinois

MORNING SESSION

With a resounding rap of the gavel, the morning session of the forty-first annual meeting of the Illinois Mining Institute was called to order by President Charles F. Hamilton, who asked that those members of the Institute standing in the rear of the room and the lobby would please come forward and take seats. This request was graciously and promptly complied with, and with the restoration of quiet, President Hamilton opened the meeting with the following remarks:

President Charles F. Hamilton: Members of the Illinois Mining Institute, and Distinguished Guests:

It gives me great pleasure to open the forty-first meeting of the Illinois Mining Institute and to see so many members present, which voices the interest we all take in our Institute.

We are privileged this morning in having with us the Mayor of this beautiful and delightful city, who will welcome us to his surroundings. I take pleasure in presenting the Honorable John W. Kapp, Junior. (Applause.)

Welcome to city by Hon. John W. Kapp, Jr., Mayor of Springfield, Illinois:

Mr. Chairman and Gentlemen of the Illinois Mining Institute:

As Mayor of the City of Springfield, and on behalf of its citizens, I want to extend to you a most hearty and sincere welcome.

Springfield, as you gentlemen all know, is the capitol city of Illinois. We have located here the capitol group of buildings, the State House in particular, and I am only too sorry that today the Legislature is not in session so that you gentlemen could be with that august body, visit them, and see how the laws of the great State of Illinois are made.

We also have here the Centennial Building, in which building are located the Illinois State Museum and the Hall of Flags. I would like to call your attention to that great old Hall of Flags, in which is displayed a flag for every military organization that ever served under this great State. Some of you gentlemen who have had experience in a military way, or who have friends or relatives who have had military experience, will be happy to see that old flag under which you or they served.

The other building in this capitol group is the Supreme Court—a very interesting place to visit.

Springfield, gentlemen, as you know, is rich in history. We have here the home and also the newly reconstructed tomb of the immortal Abraham Lincoln. I would like to ask that you pay them a visit, especially the tomb, pause a moment there and again be inspired by the spirit of that great man,—a spirit which is so much needed during these trying times.

Now, gentlemen, if you will permit me for a moment to digress from a speech of welcome, I have in my mind a thought that I would like to give you men interested in the mining business. You have probably read in the local and metropolitan press in the last week or so a story of natural gas in the glass industry. First they subsidized the press and other gentlemen with sincere motives in order to get publicity. Now I can truthfully say that I have had a wide acquaintance with the coal and gas industries. When natural gas was first introduced into Illinois (except for my city attorney) I went by myself and appeared before the Illinois Commerce Commission, objecting to it as not being an organization which should be given a certificate of convenience and necessity for selling natural gas in this State. My reason for being there was that Springfield is almost entirely surrounded by the coal industry, and as it is primarily a coal city, I thought it would hurt Springfield in a civic way. I also had in mind trying to take care of our citizens in the way of getting for them cheaper gas. I am talking about the usual household—not the industries.

We appeared there by ourselves, objecting to this certificate of convenience and necessity being issued. No one appeared with us. Afterwards, we made an attempt to try and induce the coal operators of the State of Illinois and the coal-carrying railroads to go along with us and help us in this fight about natural gas. Now I want to say to you gentlemen who are primarily interested in the coal business that you have a real fight on your hands. This was two years ago, and I think you are beginning to realize it now. I still have before the Illinois Commerce Commission one case in which I am attempting to say to the natural gas people that if they make a price to the industries for natural gas comparable to a price for coal, that we are satisfied, but if they make the price of natural gas to any industry cheaper than coal and then make the average householder pay more for it, we object to that.

My idea in saying this to you gentlemen is that that case is to be heard some time this month, and, if possible, I would like to have some sort of resolution passed by this august body to help me with my fight on natural gas as against coal. You gentlemen know, from an economic standpoint, that the coal business of Illinois is of paramount importance, and I feel, with your help, we can see that natural gas will be sold at a price where you gentlemen will be able to live—where the coal miner will be able to live—where the railroad man will be able to live—and where all will be happy. I want to say to you that this is your fight now, along with the fight that I started. I do want to apologize to you for saying this, but it was in my mind. I feel that I want to co-operate with you in every way to help the mining industry of Illinois.

In conclusion, permit me to say that if there is any way in which I can help to make your visit here more pleasant, you will find me very, very happy to do so, as I would like to have you carry away from Springfield a pleasant memory of your visit here.

(Applause).

President Charles F. Hamilton: I wish to thank Your Honor for your gracious words of welcome, which I know are thoroughly appreciated by the members of the Institute, and also the thought which you have given them, which, in my judgment, should probably be discussed a little later, and will be introduced as "New Business." I wish that we were able to take advantage of the invitation to see the many historic places of interest in this city, but we have quite a lengthy program for the morning session, as well as the afternoon, and the banquet this evening. However, if it is possible and we can find the time, we must ask you to show us all these buildings.

Your Honor, we will be very delighted to have you stay with us during our morning session, as well as our afternoon meeting and banquet.

Mayor Kapp: Thank you, Mr. President.

President Hamilton: The next order of business is the reading of the minutes of last meeting by the Secretary.

Mr. Schonthal arose to read the minutes of the last meeting, but before he started to do so, the Chair recognized Mr. George C. McFadden, who made the following motion: Mr. President, I move that we dispense with the reading of the minutes, as I think everyone here is well acquainted with the printed Proceedings. Motion seconded and carried.

Mr. Hamilton: The next order of business is the report of the Executive Board. As Chairman, I might say that one small meeting was held last November in Southern Illinois, where the general work for the year was discussed—and during the present year several communications have been sent out on matters of interest to the Institute. Not in the way of alibi-ing, but as you all know, some of us have been busily engaged with matters of a Federal and State nature and possibly the business of the Institute has been somewhat hampered in that regard. However, I think the report will show that the Institute is in a very healthy condition both physically and financially, and to confirm that statement, I will ask the Secretary to make his report.

SECRETARY'S REPORT

Illinois Mining Institute, November 3, 1933.

To the Officers and Members of the Illinois Mining Institute:

There is very little for the Secretary to report this year, aside from the statements to be presented showing the cash position and membership situation.

We have been fortunate in being able to add to our financial position, and the operation for the year shows a comfortable profit.

Due to the many difficulties that all our members have experienced during the past year, we have not been able to maintain our position from the standpoint of numbers of members as we have in the past, but we hope that the future holds better things along this line. It is the hope of the Secretary that we might be able to get our membership during the coming year up to at least five hundred active members.

I wish to express my appreciation to all the members, the executive board, and the officers for their willingness to co-operate whenever this was needed.

During the year we suffered the loss of three of our members: Mr. Joseph Viano, Mr. David I. Rock (who was a member of the executive board), and Mr. John Rollo (who was an honorary member, having been a charter member of the original Institute formed in 1892). Letters of condolence were dispatched to the members of the bereaved families.

Respectfully submitted,

B. E. SCHONTHAL,

Secretary-Treasurer.

President Hamilton: Next in order of business is the report of the auditing committee:

ILLINOIS MINING INSTITUTE

Cash Statement, November 1, 1933

REPORT OF AUDITING COMMITTEE

RECEIPTS:			
Cash on hand November 2, 1932	$981.75		
Less amount voted to secretary for extra expenses	500.00	$481.75	
Dues collected 1933 from 275 regular members at $3.00 each		825.00	
Interest earned on bonds		225.00	
Profit from year book		318.18	
Profit from boat trip		.14	
Total Receipts			$1,850.07
DISBURSEMENTS:			
General Expenses: Postage, printing, mailing, telephone, telegraph, etc.			433.73
Balance on hand in bank 11-1-33			$1,416.34

The foregoing is found to be correct.

AUDITING COMMITTEE.

Bonds Owned by the Illinois Mining Institute:

One—Chicago, Burlington & Quincy Railroad Co.	$1,000.00
One—Missouri Pacific Railroad Co.	1,000.00
One—Western Union Telegraph Co.	1,000.00
Two—U. S. Treasury Certificates, $1,000 each	2,000.00

(At the reading of the item, "Profit from boat trip, 14 cents," there was much mirth and laughter.)

President Hamilton: Gentlemen, you have heard the report of the Secretary and the financial report. What is your pleasure? I would be glad to receive a motion that they be adopted as read and placed on file.

Mr. Joyce: I make a motion to that effect. Duly seconded and carried. (Unanimously adopted.)

President Hamilton: Mr. McFadden, have you a report to make on membership?

Mr. George C. McFadden: Mr. Chairman and Gentlemen: From what the Secretary reported, it would appear that the Membership Committee was not too successful in obtaining new members, but we feel reasonably sure, as a committee, that when this meeting closes today the endeavors of the Membership Committee will have shown very good results in the number of registrations.

President Hamilton: Is there any unfinished business to come before the Institute?

Secretary Schonthal: None that I know of.

President Hamilton: We have now reached the time for new business. Is there any new business to come before the Institute?

Mr. John A. Garcia: There has been quite a little discussion among certain members, and rather earnest discussion at that, on the question of establishing a scholarship in Mining Engineering at the University of Illinois, to be sponsored by the Illinois Mining Institute. I would like to bring this question up for discussion at this time, to the end that our officers appoint a committee to discuss the subject and make a report on our River Trip next June. It is our idea that some lad from the mining camps be given an opportunity for an education at Urbana and that the movement be sponsored by the Illinois Mining Institute.

President Hamilton: The meeting is open to discussion on this suggestion.

Mr. H. H. Taylor, Jr.: Because of purposes of the Illinois Mining Institute is to promote education in coal mining within the State and because of the fact that I think we have a very able staff in a school right within our own State, I think that it is very proper that we start this very commendable scholarship fund, and I move that you appoint a committee to discuss the matter and report back in the near future, or, as Mr. Garcia suggested, on the annual boat trip.

President Hamilton: Any further discussion? There seeming to be none, the President inquired of Mr. Taylor if he understood that he made the foregoing as a motion, and Mr. Taylor replied in the affirmative, upon which the motion was duly seconded and carried.

President Hamilton: Mr. Taylor, just how many do you suggest I shall appoint on that committee?

Mr. Taylor: Three.

President Hamilton: It has been moved and seconded that a committee of three be appointed to inquire into and arrange for considering an appropriation for a scholarship or scholarships in Mining Engineering (to be available later) at the University of Illinois. I take the liberty of suggesting that the appointment of that committee be referred to the present Executive Board, so that the incoming president may have a hand in the election of it, as this administration is about at an end.

Mr. Garcia: All we ask is that the Illinois Mining Institute take this matter up, and we leave it to your judgment, Mr. President, as to how the matter be handled.

President Hamilton: Any discussion on this subject? There being none, he said that the announcement of the personnel of the Committee on Scholarship would be made at the afternoon meeting and that a meeting of the Executive Board was called immediately after the adjournment of the morning session and before the luncheon. He then inquired if there was any further new business, and Dr. M. M. Leighton, being recognized by the Chair, spoke as follows:

Mr. President, and Fellow Members of the Illinois Mining Institute:

I have a matter I would like to call to the attention of the Institute, too. I have discussed this matter previously with your President and a few others. Therefore, I feel that it is proper to bring this matter to your attention.

You have in mind that three years ago the Illinois Mining Institute took the initiative in sponsoring the establishment of Mineral Research Laboratories at the State Geological Survey at Urbana. These Laboratories, by grant of the Legislature, were established, and they have now been running about two years. The results of their researches seem to be so successful as to make the suggestion that I am going to make proper.

The position that we took at that time was that it made no difference as to the housing of these laboratories—just so we got them. Our position was: "Give us temporary space in which we may be able to show whether or not such researches as we wish to make will be of value."

The time has now come when the

evidences of those researches are apparent, in several ways. Many of you have visited the Laboratories at Urbana and many of you have heard our reports on our investigations. The exhibit of briquettes made from fine coal without an artificial binder out in the hall is one tangible result. There are others that I will not take time here to describe.

The point is—that these Laboratories, which have been running now about two years—are overcrowded and there is no room for more equipment needed to carry out fully the lines of research. Our space is entirely inadequate.

Now, it so happens that there has arisen this Public Works fund of the Federal Government of several billions of dollars which is to be allotted to various sections of the country for those things that will help aid employment and also give stability to the present economic needs of our country.

I wish to call this matter to the attention of the Institute and raise the question as to whether or not consideration should be given to the matter of asking for an allotment that would provide adequate housing for the Mineral Research Laboratories.

In discussing this matter with your President, he suggested that I bring before the Institute this statement, and that, if this body saw fit, it be referred to the Executive Committee for further consideration, with the view of an appointment of a Special Mineral Industries Building Committee.

There are one or two things I would like to mention in this connection. I am sure that you will be interested to know that in connection with the reclassification of North American coals, which is under the sponsorship of the American Society for Testing Materials, that we have been able to clear up a number of questions in regard to whether some of the Illinois coals should be classified as bituminous or sub-bituminous. It was only by having our own laboratories that we were able to study these questions and obtain scientific information which now answers these questions and makes it clear that Illinois coals should be classified as bituminous. In this work, our results were checked by the laboratories of the United States Bureau of Mines.

Now, these laboratories are in position to do that kind of thing, and while some of our work may not appear on the surface, it is being done wherever possible to support our coal industry, to extend the uses of Illinois coal and all the other mineral products in this State—and so I wish to leave this question to you, as to whether or not this matter should be given consideration by the Institute—as to whether or not a request should be sponsored by them, for an allotment of funds from Public Works in Washington for the building of our new Mineral Industries Laboratories on the campus of the University of Illinois, where these laboratories can have full facilities for their work.

President Hamilton: You have heard the very interesting presentation of a subject which I think is very proper to come before the Institute. May we not have a rather full discussion on it, or at least some action taken on it?

George F. Campbell: To bring this matter before us for discussion, I would like to move that the sense of this meeting is that we favor the proposition submitted by Doctor Leighton. I would like to move further that a committee of three be appointed to draft a resolution to be sent to the proper authorities in Washington for this purpose.

(Motion seconded and carried.)

President Hamilton: Is there any further discussion?

Harry Fishwick: Mr. Chairman, I like the idea of trying to get an allotment from the Federal Government to build such laboratories as will properly house the Mineral Research Laboratories. If it is at all possible, I think we ought to have a committee who will take time to go down to Washington and interview Mr. Roosevelt and try and get the money that way rather than through the adoption and sending of a formal resolution. What do you think about that? We can send a resolution from this body, but go along further and do everything within our power to have this proposition put through. I think it would be well to spend a little money to try and put this thing over. We have some, and if we can put this matter over, I think we ought to do it.

President Hamilton: Mr. Campbell, you moved, I believe, that a committee of three be appointed to endorse this idea and draw up the proper resolution to foster it and carry it on to—at least we hope—a happy conclusion, and the motion was seconded and carried. Is that right, Mr. Campbell?

Mr. Campbell: Yes, that is right.

President Hamilton: Any further discussion? If not, the motion is carried and the committee will be announced at the afternoon session. We are now ready for the report of the nominating committee.

Mr. Garcia: I would like to say that the Nominating Committee was made up of George F. Campbell, Paul Weir and myself. We had considerable difficulty in getting together because of Code meetings, but we have been mindful of the fact that the Illinois Mining Institute now represents the coal mining industry of the State of Illinois and we have been very zealous in our selection of the men for this honor. We have tried to get a true perspective of the coal mining industry of Illinois and we have drawn up a slate and submitted it to your Secretary, with the earnest request that you gentlemen will endorse it.

REPORT OF NOMINATING COMMITTEE

Read by Mr. Schonthal.

November 3, 1933

To the Officers and Members of the Illinois Mining Institute:

We, the undersigned, constituting the Committee on Nominations, offer to this meeting the following list of officers and executive board for the coming year:

OFFICERS

President—H. A. Treadwell, Benton.
Vice President—C. J. Sandoe, St. Louis.
Secretary-Treasurer—B. E. Schonthal, Chicago.

EXECUTIVE BOARD

W. J. Austin, Chicago.
P. W. Beda, Chicago.
Paul Halbersleben, Harrisburg.
Charles F. Hamilton, Chicago.
Dr. M. M. Leighton, Urbana.
Geo. C. McFadden, Chicago.
John G. Millhouse, Springfield.
Fred S. Pfahler, Gillespie.
E. F. Stevens, St. Louis.
H. H. Taylor, Jr., Chicago.
T. J. Thomas, Chicago.
Paul Weir, Centralia.

Respectfully submitted,
JOHN A. GARCIA,
Chairman.
GEO. F. CAMPBELL,
PAUL WEIR.

President Hamilton: You have heard the report of the Nominating Committee. What is your pleasure?

Mr. McCulloch: I move that the

report be adopted as read. Seconded and carried.

Preisdent Hamilton: I believe that a motion will be in order at this time to instruct the Secretary to cast a unanimous ballot for the election of the officers as nominated. Motion was made, seconded, carried and the Secretary announced that the slate was unanimously elected.

President Hamilton: Any other business?

Mr. B. E. Schonthal, Secretary, read a communication from Mr. Eugene McAuliffe; also a wire from Paul Weir.

Mr. Hamilton: This closes the business session of our meeting and we are ready to launch into the program. It gives me great pleasure to call as Chairman of the morning session Mr. George C. McFadden, Vice-President of the Peabody Coal Company.

(Applause.)

Mr. George C. McFadden: Mr. President and Guests: I wish to call your attention to the announcement on the back of your program. My good friend Doctor Leighton has an exhibit on the outside and there will be someone in attendance there who will be able to give you any information you want as to the experimental work that has been carried on in the manufacture of briquettes by the Mineral Research Laboratories. A little later on, before we recess, I will announce where to get your luncheon and banquet tickets.

The first paper to be presented this morning is entitled: "The Physical Construction of Illinois Coal and its Significance in Regard to Utilization", by Dr. G. H. Cady, Head of Coal section, and Dr. M. M. Leighton, Chief, Geological Survey, Urbana, Ill.

The paper will be read by Doctor Leighton and will be illustrated with motion pictures. Gentlemen, you all know Dr. Leighton.

Dr. M. M. Leighton: (Applause.)

Mr. President and Gentlemen: Before beginning the reading of our paper, I might say we welcomed the opportunity to place on exhibit in the outer hall here the results of our work of briquetting Illinois coal fines without a binder. I may say in that connection that these are the results of an extra intensive study of the whole question of the compression and impaction of Illinois coal fines. In the case of compression, we found that that was to be discarded. In the case of impaction, we found that there is a decided promise that Illinois slack can be compacted under certain conditions of compaction, making the briquettes 2½" in size, without the use of an original binder. The investigation has not yet been completed, as we wish to take up such questions as the permissible range of ash in coal slack; also the question of the impaction of dust in which there is a great overlay of fusain, which affects impaction—also questions on the fusain tests of these materials—but we wanted to bring this question to your attention at this time in order that we might receive from you any questions or any suggestions that might help us in rounding out this investigation in the most profitable way for the industry.

I wish to say before reading our paper that there was a typographical error in the title as printed on the program. It should have read: "The Physical Constitution of Illinois Coal and its Significance in Regard to Utilization."

THE PHYSICAL CONSTITUTION OF ILLINOIS COAL AND ITS SIGNIFICANCE IN REGARD TO UTILIZATION

By GILBERT H. CADY
Illinois State Geological Survey

Presented by M. M. LEIGHTON
Chief, Illinois State Geological Survey

Introduction

Within the last twenty years, and mainly within the last ten years, there has developed a new technique of coal investigation based on a study of coal as a rock substance rather than as a complex chemical compound. The discriminating information which Reinhardt Thiessen of the Bureau of Mines has assembled on the petrographic characteristics of a large variety of American coals indicates the most promising means of unraveling the tangled skein of coal composition.

The investigations by the Illinois Geological Survey of the physical constitution of Illinois coal in accordance with the procedure of the new technique of coal investigation has been underway for about three years, but the studies were expanded in 1931 when the Survey, through legislative grants, found it possible to enlarge its research activities. The present paper describes briefly the physical constitution of Illinois coal as revealed by microscopic study and suggests the practical value of the more accurate knowledge of the physical character of coal. An understanding of the nature of the physical constitution of coal is, we believe, the best basis for the study and interpretation of chemical attributes, and with the chemical data, provides a fundamentally sound basis for experimental research. Practical application rests largely with the engineer.

1. The Physical Constitution of Illinois Coal[1]

General characteristics.—Illinois coal is predominately of one general type, that is, normal, banded, bituminous coal. It varies in rank from bituminous medium-volatile coal to bituminous high-volatile high-moisture coal, the coal of lowest rank being little removed from coals known as subbituminous. From the standpoint of rank there is, therefore, a relatively narrow and yet a definite range of variation among Illinois coals which permits of discriminating marketing on the basis of rank characteristics—namely calorific value, moisture content, and carbon ratio.

Within each rank of coal, representing a stage of coalification, various types of coal are found, each type representing concentration of

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[1] The microscopic investigations of coal by the State Geological Survey have been carried on largely by L. C. McCabe, who is also responsible for the photographs shown. Studies in mineral constituents of coal are being made by O. G. Ball. Macerated residues have been investigated by L. C. McCabe, J. M. Schopf, and O. J. Henbest. The thin and polished sections are prepared by W. S. McCabe. The author gratefully acknowledges his indebtedness to these associates for the technical data presented in this paper.

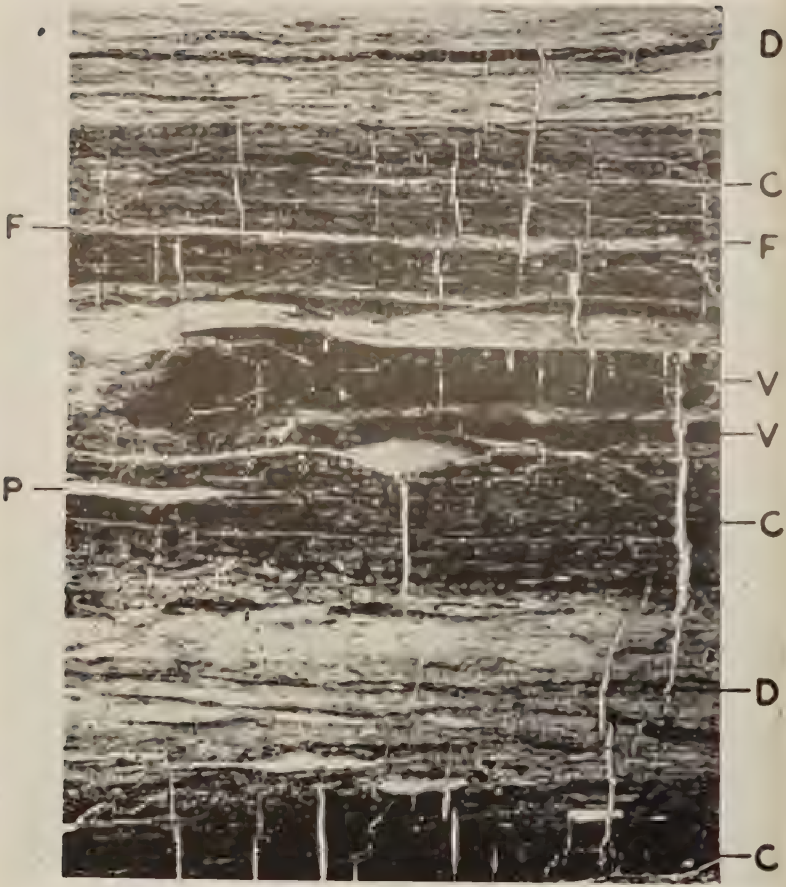

Fig. 1. A polished surface of an Illinois coal. (X 2)

D. Durain, dull or splint coal with thin streaks of bright coal (vitrain). A relatively uncommon ingredient in Illinois coals.

C. Clarain, bright but definitely laminated or striated coal. Most Illinois coal is clarain.

F. Fusain or mineral charcoal, appears white in the photograph due to its tendency to reflect light. It is actually the blackest ingredient in the coal.

V. Bright coal of uniform, unstriated appearance. The most conspicuous ingredient in the coal and the one largely responsible for its banded appearance.

P. A small lens of iron pyrites ("sulfur"). It is difficult to distinguish from fusain in the photograph. The small thick lens about the center of the photograph is a lens of fusain.

certain kinds of coal-forming material. The three most widely recognized types of coal are normal banded bituminous, such as that common in Illinois, cannel coal, and bog-head coal. Normal banded bituminous coals are derived from forest swamp peats, and hence are predominately woody in origin. Cannel coals contain less woody material, consisting largely of windborne plant constituents, such as spores and pollens, deposited in open water areas in the coal swamp. Algal or boghead coals, as their name implies, are derived from algae, also in more or less open water localities in the coal swamps. No algal coals and but few cannel coals are known in Illinois.

The statement that Illinois coals are predominately of the banded bituminous or forest-peat type indicates that they consist of a closely matted aggregate of the various plant parts and plant secretions which contributed to the forest peat. The specific character of any coal of this generalized type is determined by the extent to which the different components contribute to its consitution.

The Banded Ingredients

The most obvious effect of differences in the plant parts that contributed to the coal material is the banded consitution of the coal (Fig. 1). The bands represent the cross sections of thin lenticular layers of different coal material as they appear on the joint and fracture surfaces. There are three main types of bands in Illinois coal seams and a fourth less common type: (1) The jet-black, brilliant, mainly structureless bands; (2) the bright more or less faintly laminated bands that make up most of the coal, and (3) the mineral charcoal or fusain. Occasionally (4) there are bands of distinctly dull coal which appear to be either highly mineralized bright coal or in the nature of splint coal which is not necessarily of high mineral content. These three common varieties, with the fourth uncommon variety, of coal material have been called by Stopes[1] the **Petrographic ingredients** of coal. Although recognizable in other ranks of coals they are particularly characteristic of bituminous coals and are significant because each petrographic ingredient possesses a characteristic physical constitution inherited from its swamp forest origin and determined by the kind of plant materials of which it is composed.

To avoid the use of elaborate explanatory phrases, Stopes applied names to these petrographic ingredients. The brilliant jet-black coal was called **vitrain**; the bright, laminated, coal, **clarain**; the mineral charcoal, **fusain**; and the dull coal, which is not commonly present in Illinois coals, **durain**, which Thiessen[2] regards as the same as American splint coal.

Illinois coal is usually composed predominately of clarain; it contains variable amounts of vitrain up to possibly 25 per cent, fusain rarely in excess of 10 per cent, and durain rarely in excess of 5 and usually less than 2 per cent.

These figures interpreted in terms of tonnage for Illinois coals become imposing when it is realized that between 2-1/2 and 5 million tons of fusain. and 12 to 15 million tons of

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[1] Stopes, Marie C. "The Studies on the Composition of Coal". The Four Visible Ingredients in Banded Bituminous Coal. Proc. Roy. Soc., London, Vol. 90 B, p. 470.

[2] Thiessen, Reinhardt, Recently developed Methods of Research in the Constitution of Coal and their Application to Illinois Coals: Illinois State Geol. Survey. Bull. 60, pp. 117-147 1931

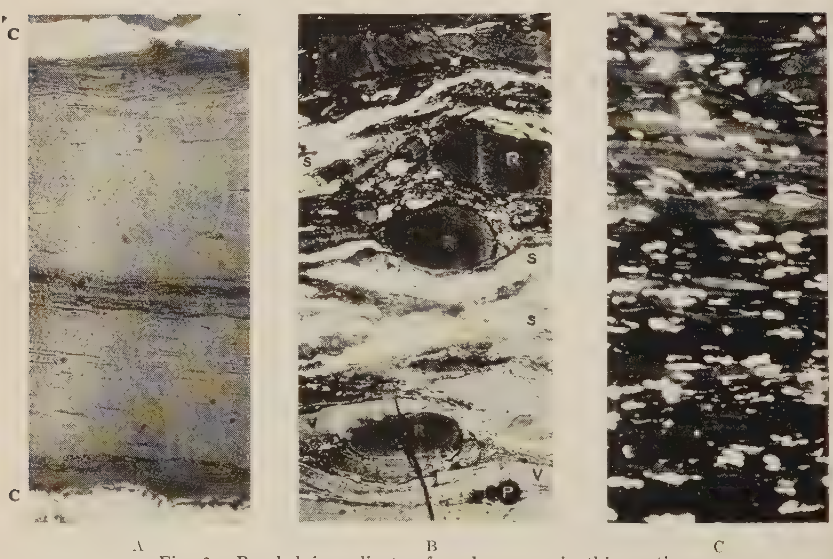

Fig. 2. Banded ingredients of coal as seen in thin sections.

A. Vitrain band. This is translucent and uniformly bright orange red in color. The band (V) shown here probably represents a section cut lengthwise of the stem. It is bounded above and below (C) by a bright (yellow) band possibly representing outer waxy tissue (cuticle?). (X150).

B. Clarain band. This is translucent, orange red (vitrain shreds, V), wine red (resins, R) and yellow (disintegrated spores, S) colors prevail. Certain round black areas are pyrite (P). The photograph shows very definitely the heterogeneous physical constitution of clarain. (X150).

C. Durain band. This is largely composed of opaque material. Extreme thinness of the section is essential in order to overcome the density of the opaque material in durain. The small white dumb-bell shaped areas in the photograph represent microspores which lie as flattened spheres in the plane truncated by the thin sections. Their frequency is rather typical in this type of coal but larger spores as shown in Fig. 7, B, are even more characteristic of durain. (X150).

vitrain are produced annually by Illinois mines.

The vitrain bands contribute most to the banded appearance of Illinois coal. These are always present but vary a good deal in their width and frequency. In Illinois coals vitrain bands rarely exceed an inch in width and are usually less than one-half inch wide. It is only those that are about 1/16 inch or more in width that are recognized as distinct bands, but they are present as fine shreds or as micro-vitrain within the clarain.

Vitrain (Fig. 2A) is exceedingly brittle and resilient and breaks up into small irregular sharp-edged fragments both when the coal is shattered and upon drying out. Layers of vitrain are commonly crossed with fine shrinkage cracks filled with white crystalline kaolinite (Fig. 3), or calcite which is very closely restricted to the width of the vitrain band (Fig. 2A). In fine sizes of coal the kaolinite is largely broken from the vitrain. Vitrain has a low specific gravity (less than 1.30) due to its low ash content and a high luster. In high sulphur coals pyrite may be present in disseminated form or as joint facings. Vitrain is translucent and is red in thin sections. It takes a high polish on polished surfaces.

Fusain (Fig. 4), is the source of the sooty "dirt" which accompanies Illinois coal. Much of it is loosely attached and is shaken loose during preparation processes and concentrates in the small sizes. Much the larger proportion of the dust below 100-mesh recovered in the dedusting process is fusain. It is present in fine needle-shaped particles which seem capable of subdividing into almost indefinite fineness. It also has a relatively low specific gravity (less than 1.30) when pure, but adhering and impregnating mineral matter is common so that much fusain has an apparent specific gravity much above

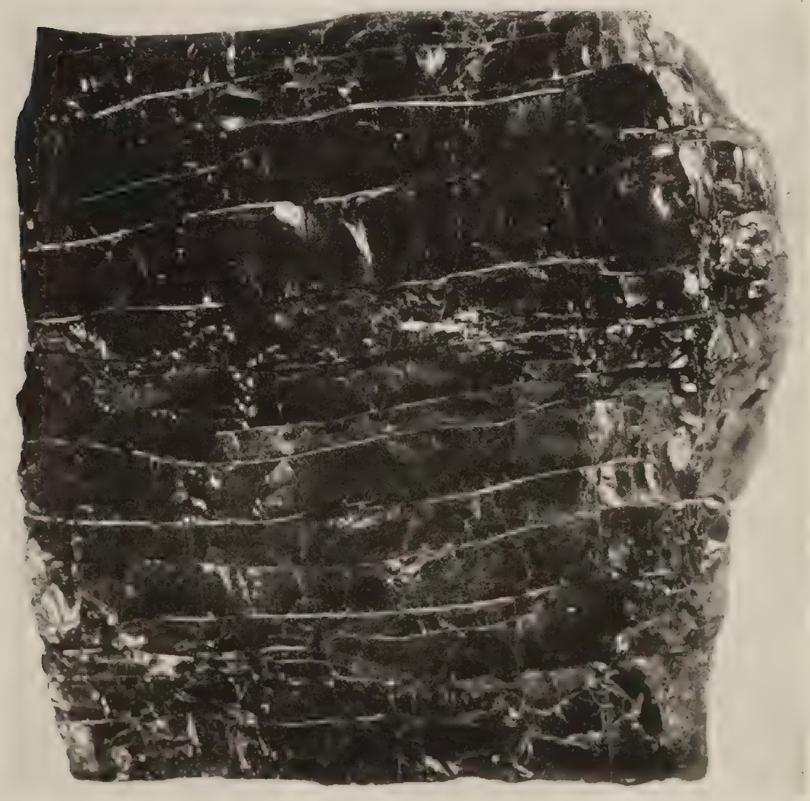

Fig. 3. Kaolinite in vitrain. (Natural size)

A block of bituminous coal from Indiana broken in a vitrain band to show kaolinite (white) in the shrinkage cracks which are confined to this band. Such occurrence of kaolin and calcite has been observed in Illinois coals.

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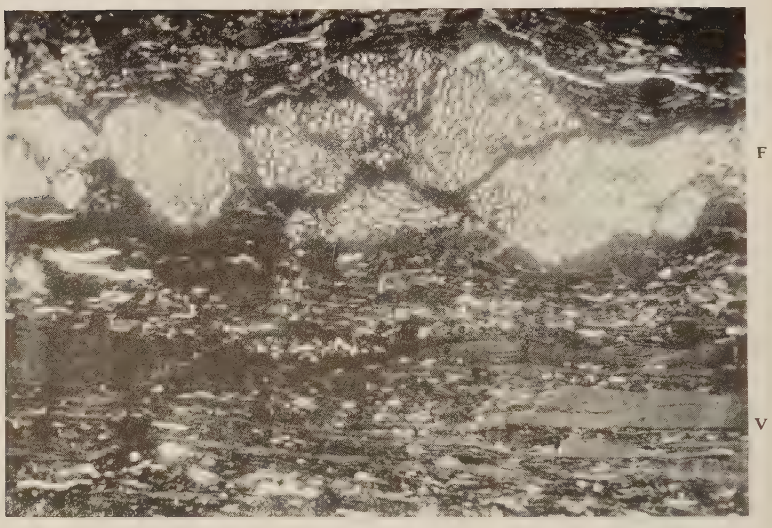
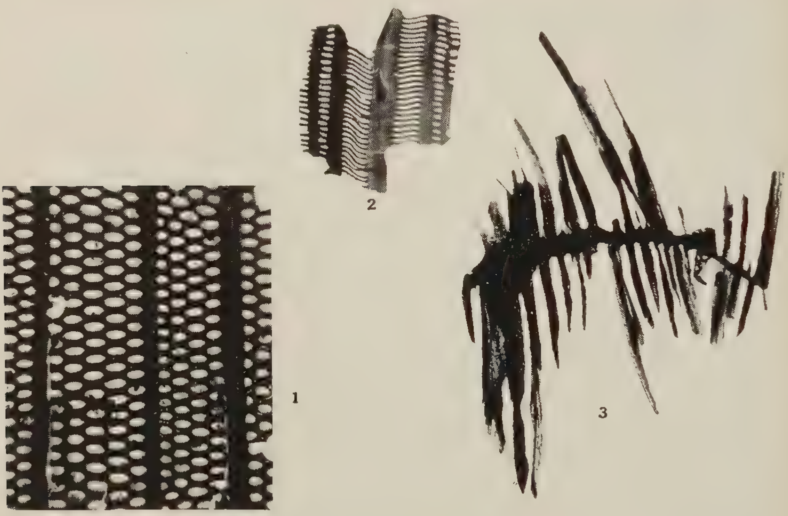


A. Fusain in thin section (F) showing its opaque character and distinct plant structure (X60). The cavities shown are commonly filled with mineral matter. The material below the fusain is clarain containing microvitrain strands (V) and numerous small white areas representing microspores (Fig. 7A4).



B. Fusain fragments obtained by macerating Illinois coal No. 6, showing traces of several varieties of plants.

(1) A fusainized wood fragment of a fern type of plant showing well preserved delicate structures. (X65).

(2) A fusainized wood fragment of a primitive pine type of plant. (X35)

(3) A fusainized wood fragment from a plant of the horse-tail group, showing a portion of a node or joint in a stem. (X50)

Fig. 4. Fusain.

1.4. Fusain is opaque in thin sections.

Clarain (Fig. 2B is relatively tough and is usually distinctly fine to micro-laminated. It usually comprises all the coal that is neither vitrain nor fusain. It grades with increase in the amount of micro-vitrain into vitrain, or as the opaque matter increases, into durain, which has the general appearance of dull clarain, or as mineral impurities increase into "bony" coal. Clarain is less easily broken than vitrain and breaks more irregularly with less sharp edges. It is translucent and varies from red to bright yellow in thin sections.

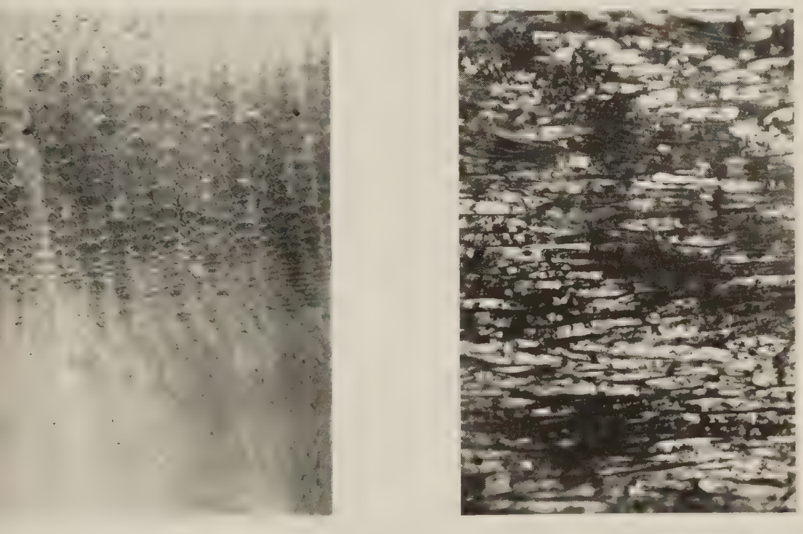
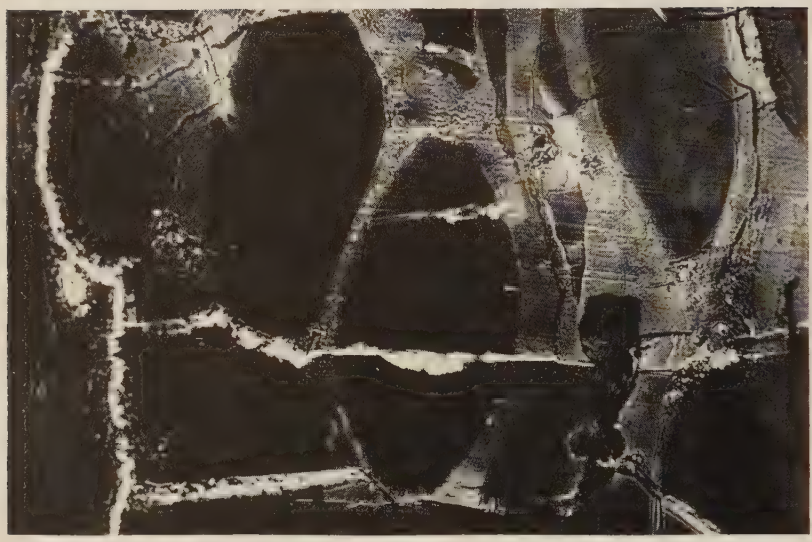


Fig. 5. Vitrain bands showing cell structure.

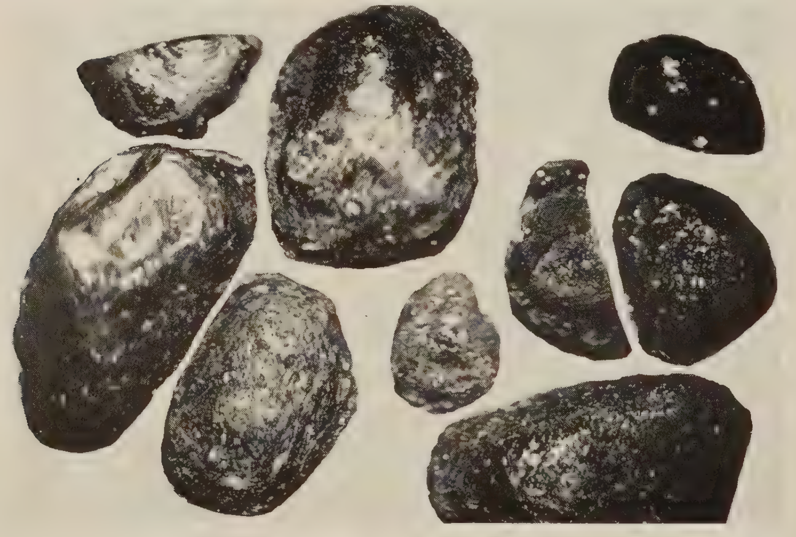
A. Wood cells in a vitrain or anthraxylon band representing a transverse section of a stem. (X100).

B. Wood cells in vitrain (anthraxylon) representing a section of a stem cut approximately lengthwise of the stem. (X100).

Typical **durain** (Fig. 2C) is laminated like clarain but has a distinctly dull luster with a slight grayish tone. This grayness is more evident in photographs than in the coal itself (Fig. 1, D), although it can usually be distinguished in polished hand specimens. Microscopically, typical durain sections of usual thickness have an opaque groundmass usually containing red to bright yellow translucent areas representing spores. Megascopically durain has much the appearance of "bone coal" and in fact some durain undoubtedly contains much mineral matter, but a high mineral matter content is not an essential concomitant of durain. In Illinois coals durain occurs in bands usually about a half inch, rarely over one inch, in width which are probably generally regarded as "bone". In general their actual character cannot be determined except with the microscope. Durain as has been stated, is

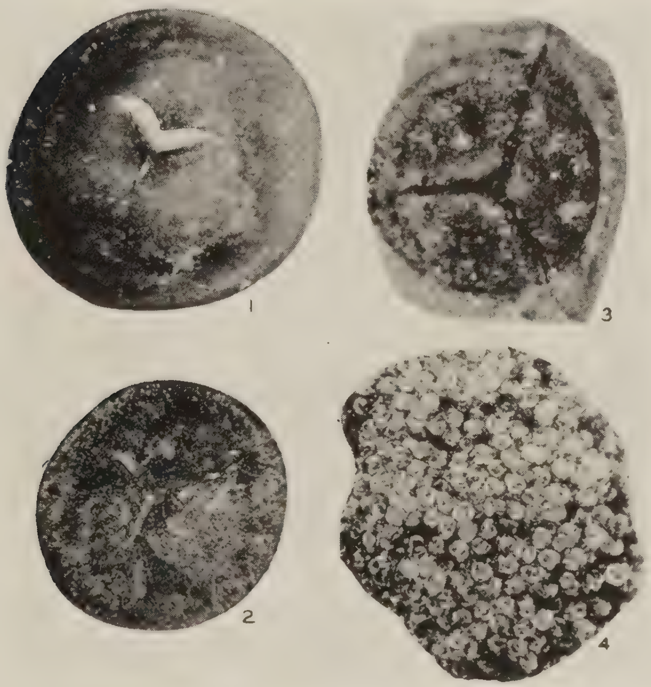


A. Resins in a band of vitrain. They are translucent, wine or mahogany red, elliptical areas embedded in an orange-red background characteristic of vitrain. The cell structure of the vitrain is not apparent. See also Fig. 2, B. (X200).



B. Resin droplets isolated by maceration from Herrin No. 6 coal. (X15). Resin also commonly occurs in needle-like rodlets readily visible without microscope.

Fig. 6. Resinous bodies.



A. Spore exines isolated by maceration.

(1) and (2) Smooth wingless spores commonly as large as the head of a pin. (1,X20) (2,X20).

(3) Winged spore with triradiate markings extending from center to circumference. These are the traces of the junction of the four spores originally grouped together in the sporangium. (X50).

(4) Microspores. These often occur in great numbers on the horizontal laminae of the coal. (X30). The white dumb-bell shaped areas in Fig. 2C are microspores as they appear in cross section.

Fig. 7A. Spore exines.

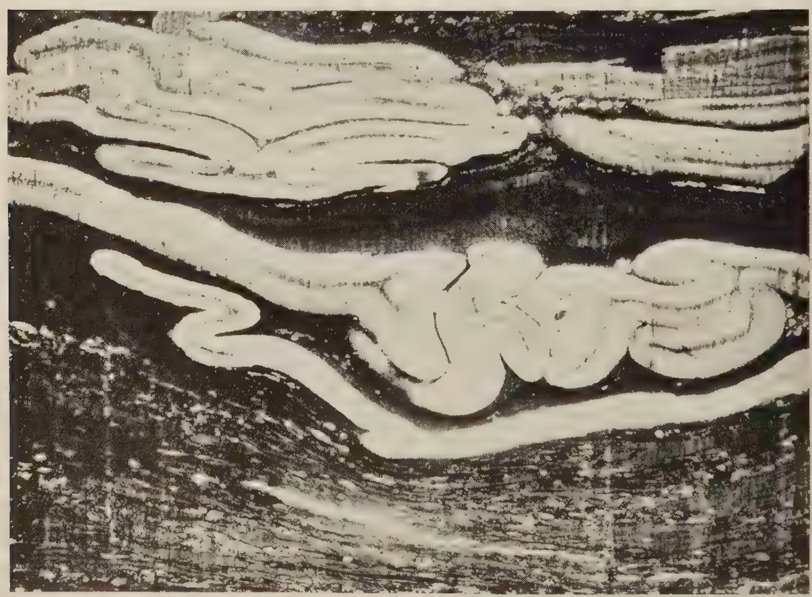
elieved to correspond to the American "splint" coal.

It is no particular accomplishment to have pointed out the banded character of mid-western coals as this is ne of their outstanding characteristics. However, until recently no ne seems to have understood its significance or what might be done about it. Coal continued to be regarded simply as coal. It is an achievement of modern coal research to have aroused a more discriminating understanding of the physical nature of coal, thereby raising doubts as to the adequacy of the earlier methods of description, analysis, and preparation. It must be obvious even to those inexperienced in methods of technical and engineering procedure that an awakened realization of the existance of definitely distinguishable physical constituents in our coal is to be preferred to the previous indolent attitude of regarding coal as a uniform material. At any rate we put ourselves in a position receptive of new ideas in regard to the chemical and physical composition of coal and the possible effect of different methods of mining and preparation upon the finished product.

Plant Components of Illinois Coal

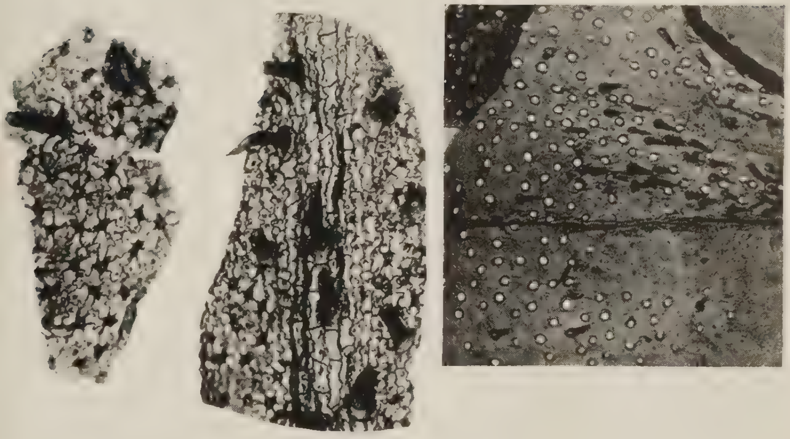
The nature of a banded coal is not fully expressed in terms of its banded ingredients. It is only as the constitution of these ingredients is understood that the nature of the coal and the possibilities of variation are understood. The physical constitution is revealed by the microscope. Thiessen has provided us with two convenient terms as names of plant constituents and aggregates found in coal. Coalified woody substances he calls **anthraxylon,** whatever the rank of the coal. Non-anthraxylous material is grouped under the general name **attritus.** Attritus is of two sorts, the translucent (or lucid) and opaque. Opaque attritus is characteristic of durain in splint coals. By this classification cannel and boghead coals are attrital coals. Thiessen also uses the term **fusain** in referring to mineral charcoal.

In general vitrain (Fig. 2A), is anthraxylous in constitution, that is, it is composed of coalified wood, but much vitrain of Illinois coals is composed largely of resinous bodies (Fig. 6). Clarain (Fig. 2B), is predominately attrital, although very bright clarain may contain much anthraxylous material and differ but little from vitrain. Durain (Fig. 2C) is opaque attritus. Fusain, like vitrain, is derived from wood but it is carbonized wood rather than coalified



B. Large thick walled megaspores closely crowded together as found in a thin section of No. 6 coal from Montgomery County. (X75).

Fig. 7B. Spore exines.

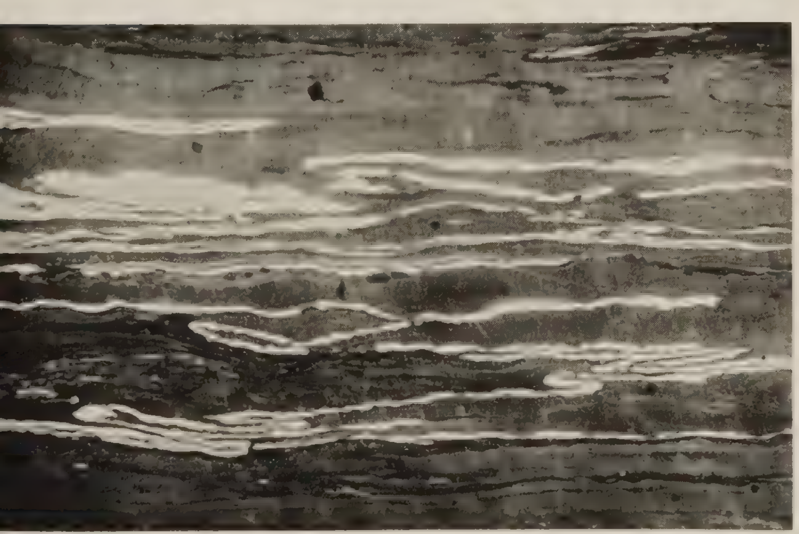


A. Cuticular tissue isolated from coal No. 6 of St. Clair County by the maceration process.

(a) Cuticle with spiny protuberances (epidermal hairs). (X37).

(b) Cuticle showing one spine and star-like surface markings indicating the position of the stomata. (X37).

(c) Epidermis, possibly of an insect, with spines and the holes caused by their removal. (X50).



B. Thin section showing waxy shreds probably cuticular matter in clarain. (X75).

Fig. 8. Cuticles.

wood, and so is not regarded as anthraxylon.

The recognizable plant constituents in coal are of three main sorts: (a) Woody materials, (b) resinous secretions, and (c) waxy secretions, organs, and tissues. The woody materials, when preserved, constitute the lenses and strips of vitrain, and when carbonized they constitute the fusain. Resins (Fig. 6) too are present in vitrain, but they occur also in the clarain as tiny rodlets and droplets, isolated, or in aggregates. Waxy bodies found in the clarain and durain represent the more resistant parts of the plants so that they appear with their original form more or less well preserved as spore cases or exines (Fig. 7), cuticles (Fig. 8), and as wax droplets. Vitrain may be either predominately anthraxylous or largely resinous. Clarain is variable; it may be largely anthraxylous or highly waxy. Durain like clarain, is commonly waxy (Fig. 2C. Since it is evident that the characters of the banded ingredients differ because each is composed of a more or less characteristic type of plant constituents, it is evident that the character of the coal varies with the variation of the amount of each of the banded ingredients.

In this brief summary it is possible only to suggest the nature of the physical constitution of Illinois coal and the possible variations in the coal due to local concentration of certain parts or secretions of plants. In general the important plant components which can be identified as contributing to the coal substance are as have been listed. All are more or less common to all plants, but there is obviously possibility of great variation in the extent to which each of these substances may contribute to the coal due to local conditions determining the concentration of each.

Mineral Constituents

Coal contains both inherent and extraneous mineral matter. In microscopic studies we are concerned primarily with extraneous non-organic mineral matter, either that washed, blown or carried into the coal swamp at the time the coal was deposited or secondary mineral matter deposited from solution. In ordinary clean coal that is free of shaly partings—which are really not part of the coal substance—extraneous mineral matter consists largely of secondary mineral matter. This is chiefly pyrite or marcasite, calcite, and kaolin.

Pyrite and its occurrence in coal is generally known. In large masses it occurs as nodules and plates of earthy or stony pyrite, as impregnations, and as joint "faces". Occasionally it is found impregnating and apparently replacing fusain.

Calcite occurs in coal mainly as facings of joint cracks and occasionally as petrifications known as "coal balls" or as large irregular brownish masses of limestone whose shape suggests that they are petrified portions of woody stems or branches sometimes called "coal balls".

Kaolinite.—The third mineral listed and the one which in many Illinois coals is quantitatively of greatest importance is kaolinite. A sample collected for analysis from Franklin County No. 6 coal had the following composition as determined by the Illinois Geological Survey Analytical Laboratory:

Analysis of kaolinite from Franklin County No. 6 coal.

$Si0_2$	43.80	per cent
Fe^20^3	.82	
Al_20_3	39.36	
Mg0	.16	
Ca0	1.17	
Loss on ignition	15.40	

This was in essential agreement vith the analysis by the Bureau of Mines of a sample from a Franklin County coal and indicates that the nineral has very nearly the composiion of the mineral kaolinite. Deailed studies by Mr. Clayton G. Ball f the Illinois Geological Survey has stablished the importance of this nineral in our coals. Its most charcteristic occurrence is as shrinkage-rack facings in the vitrain.

This mineral is of considerable imortance in coal. In general the oals low in pyrite content will have relatively high kaolin content, and s a result the ash is relatively reractory. In low sulphur coal unloubtedly the coal mineral of greatst importance is kaolinite. This of ourse assumes that the bands of lay or shale possibly interbedded vith the coal are not included as oal minerals but are removed in the leaning process.

In addition to the three important ninerals which are mainly of secndary origin, a few primary minrals such as quartz, feldspar, zircon, arnet, etc., are present just as they re likely to be in any sedimentary ocks. Many of these were probably lown into the coal swamp. Such nineral matter is unimportant in omparison with the secondary minral matter noted. Gypsum is comnonly regarded as an important oal mineral but this does not seem o be the case as far as Illinois coals re concerned. The sulfate sulphur f Illinois coals is always minute in uantity and occurrences of gypsum s facings seem to be rare.

This description of the plant and nineral components of coal provides general idea of the nature of coal etrography and of the character of ne ingredients and constituents posble of determination and differenation. It gives little idea of the technique of investigation and of the possibilities of differentiating the physical components of Illinois coals nor does it mention the dependence of the investigations upon the related studies in coal botany which are so essential to an understanding of coal geology. These matters, however, are not particularly pertinent to this occasion.

Attributes of the coal constituents

The physical heterogeneity of Illinois coal has little practical significance unless the various constituents possess significant individuality in composition and attributes and can be fairly easily isolated.

Attributes of special constituents

In considering the specific attributes of the components of coal only generalized statements can be made. Each is likely to prove only partly correct as knowledge increases. It will be my good fortune, indeed, if any prove eventually to have merit. Let us consider the character of the four most commonly and easily identified constituents in coal, namely (1) coalified wood, or anthraxylon, (2) resins, (3) waxes, and (4) carbonized wood or fusain.

It is doubtful whether wood exists as wood in coal material advanced to the rank attained by Illinois coal. A derivative of woody substance probably represents the original lignified woody stems and fibres. What this coalified derivative (anthraxylon) may now be is not well known. We find that these once woody parts of Illinois coals when oxidized either artificially or in nature are soluble in alkaline solutions. When reprecipitated and dried they again form a solid jet black gel resembling the vitrain bands from which much of the material was probably largely derived. A thorough understanding of the nature of Illinois coal calls for chemical investigation of this humic material which probably makes up about three-fourths of the coal substance.

Resins or resinous material more or less modified by coalification exist in great quantities in Illinois coals. Although the properties of resins of living plants have been thoroughly explored, we do not know the effect of coalification upon the resins. This is an inviting field for chemical investgation for if resinous bodies exist as such in Illinois coal to anywhere near the extent that seems probable from microscopic determination, they must exert some influence on the character of the coal.

Waxy substances that occur in great quantities in some coals represent the more resistant portions of the plants such as the outer sheath of stems and leaves, individual granules, and larger part of the exine or outer covering of spores and pollens. Such substances form a large portion of cannel coal and give it its highly volatile character evidenced by its long smoky flame and are particularly numerous in splint coals (durain). In general waxy bodies are less modified by the coalification process than any other plant forms except possibly those parts which have been fusainized. Cuticles and exines can be isolated from the coal by maceration (Figs. 7 and 8) showing their original surface markings and often showing but slight evidence of carbonization. It is probable, therefore, that these substances retain more of their original attributes, whatever they may be, than any other substances recognizable in the coal. Undoubtedly resistance to change is one of their characteristics and their general highly volatile character is another.

Fusain or mineral charcoal is carbonized rather than coalified wood. Because it is concentrated in bands and is readily isolated its character is well known at least so far as it can be expressed in terms of the proximate and ultimate analysis. Like anthraxqlon it is obviously no longer wood but a derivative of wood through some process of carbonization. It will neither dissolve in alkalies nor swell when heated. Its properties are fairly uniform, being composed of about four-fifths fixed carbon and one-fifth volatile matter or less on the ash and moisture free basis, irrespective of the rank of the coal in which it is found, at least for a wide range in rank. Since our Illinois coals contain an unusually large amount of fusain their character is necessarily modified thereby.

Attributes of the Banded Ingredients

As has been explained, the banded ingredients represent types of coal substance; that is to say, concentrations of one or more of the plant constituents found in the coal. The attributes of the bands indicate the general characteristics of the materials of which they are composed. The bands are relatively easy to sample, whereas samples of the plant ingredients in pure form would be exceedingly difficult to obtain except in instances where the bands were composed of a single variety of plant constituents. The bands other than fusain, however, are rarely composed of single plant substances. Vitrain is in some cases entirely of woody origin without resin, although usually resinous bodies are present. Vitrain rarely contains waxes, whereas clarain is likely to have much waxy material present.

Within the last few months we have had an opportunity to collect information in regard to the chemical composition of the banded ingredients of some of our coals, re-

resenting several beds in various arts of the State. The following eneralizations seem justified with espect to vitrain, clarain, or fusain.

(1) Vitrain is characteristically ow in ash—in some coals the vitrain amples contained less than 1 per ent ash. Out of 17 samples the ighest ash content was less than 3 er cent.

(2) The sulphur content is usually ow in vitrain but may be higher than he ash content. The amount of rganic sulphur usually exceeds the mount of pyritic sulphur commonly s much as two to three times, hence t is probably largely volatile sulphur.

(3) The unit coal B. t. u. value of itrain is somewhat less than that of he whole coal or of the other ingred-ents.

(4) The moisture content of vit-ain is slightly higher than that of larain. Vitrain appears to possess onsiderable capacity to retain mois-ure.

(5) In general the volatile content nd pure coal B. t. u. value of clarain xceeds that of vitrain but the ash ontent is higher. Hand picked clar-in of course will not have as high sh as the entire face samples. The ariation in ash content in seven amples of clarain was from 4.2 to .7 per cent ash with coals ranging p to 9.8 per cent ash.

(6) Fusain on a unit coal basis sually shows a heat value of about 5,000 B. t. u. Analysis of 13 sam-les showed a range of unit coal val-es from 14,590 to 15,440 but 10 f these did not vary more than 150 nits from 14,500.

(7) The moisture content of fusain s very erratic but is rarely less than 5 per cent and usually more than 0 per cent in the mine sample.

(8) The ash content of fusain is lso variable. No samples showed less ash than the vitrain from the same locality, but samples might show more or less ash than the whole coal or clarain.

The mineral matter in the banded ingredients varies considerably both in kind and amount. Fusain is the single porous ingredient or constituent in coal and for that reason probably frequently contains a high percentage of mineral matter filling original pore spaces. Pyrite is the most common mineral in fusain but both kaolinite and calcite may be present. Kaolinite occurs mainly as fillings of small cavities representing the original cells. The mineral matter in clarain consists predominately of detrital clay, secondary calcite, disseminated pyrite and kaolin. The kaolin in clarain occurs mainly as fillings of small cavities in fusain fragments, to a small extent as joint fillings, and in the form of detrital clay. Calcite occurs mainly as joint fillings.

Summary. Such limited and general information as is available in regard to the organic constituents and banded ingredients of Illinois coals indicate that it consists of an aggregate of plant constituents and mineral substances. Supported by what is known concerning the character of the original components and the character of the banded ingredients the assumption seems warranted that the coal components possess individual and peculiar characteristics.

III. Practical Significance of the Modern Rational Ideas of Coal Constitution

It has been my desire in describing the newer methods of coal investigation to show that such investigations are reasonable or rational in their procedure, in contrast with the previous methods which were conducted without regard to the very evident physical structure of coal. The superiority of the rational method of investigation over a method which proceeded on the assumption that coal is simply a compound of volatile matter, fixed carbon, moisture, and ash is apparent.

The main result of considering coal from the newer point of view is that attention is transferred from the coal as a substance undergoing combustion to a natural rock substance consisting of an aggregate of different constituents. From this point of view it follows that a correct understanding of the aggregate requires examination and understanding of the constituents.

Is it not apparent that if full advantage is to be obtained from investigations projected on the newer rational basis, the whole general attitude toward coal must conform? Mining, preparation, and combustion problems must be restated in the new terms in order that solutions to such problems may be found in the results of investigations projected or underway.

The point I wish to make is briefly this: Since a rational consideration of the nature of coal requires that the procedure of investigation is first the determination of the identity of the visible and obvious components of coal, next the determination of their physical characteristics and attributes, then the discovery of their more hidden chemical characteristics and attributes, it would seem logical that matters relating to coal classification, preparation, and utilization should be similarly organized.

Inasmuch as the advances in our rational procedure in coal investigation with respect to the nature of the coal aggregate have been small it is possible to indicate the practical significance of a rational point of view only with respect to the more general attributes of coal. It will be impossible without indulging in unwarranted speculation to give more than a few definite examples of the general effect of adopting the new point of view toward coal. These, however, will be sufficient to indicate the general tendency.

(1) The most important general effect that will result from a more discriminating understanding of the nature of coal will be a greater accuracy of description, classification, and grading because of the increasing precision in the standards of evaluation and comparison.

(2) Establishing the existence in the coal of readily differentiated physical constituents provides a natural basis for developing methods of artificially modifying or controlling the character of coal or of preparing fuels of definite attributes by artificial blending. It is apparent that in the early stages of advancing knowledge only the more obvious differences will be of importance or even known. At the present time the most obvious differences are those that exist between the different banded ingredients.

(3) The nature of the separable components will of course determine the physical conditions under which separation can take place. In the case of the banded ingredients, for example, the thinness of the bands obviously determines to a large extent the size to which the coal must be crushed if satisfactory concentration of the banded constituents is to be accomplished. In order to take advantage of any benefit that might result from selective preparation, coal would have to be reduced to fine sizes. Whether or not any such advantage might accrue depends on the nature of the ingredients and

nce some have very positive and
nique attributes that are readily
scernible the first efforts at separa-
on will probably be applied to these
gredients, particularly to fusain.

(4) A better realization of the
ature of the mineral constituents of
al and the effect of variations in
nd as well as in quantity will prob-
ly eventually result in efforts to
ntrol the fusion temperature of the
h modifying the relative quantity
the various minerals present, par-
cularly as it is realized that the sig-
ficant minerals are few in number.
will probably be realized that quan-
ty of mineral matter may be a less
rious handicap than its character.

These four items represent the
ore obvious practical effects or pos-
ble effects of assuming a rational
titude toward the constitution of
al. They rest upon or rise from
al differences in coal apparent at
e very threshold of the rational
arch for the nature of coal mate-
al. Other attributes and differ-
ces will necessarily be of a less
vious character and hence some-
hat or even much more difficult to
scover, but none the less real. It
obviously impossible to foretell the
actical application of such discov-
ies until they are made. Otherwise
e would scarcely go to the trouble
investigation. The justification
r continuing such investigations
sts not in the assurance that dis-
veries will have this or that prac-
cal application but in the validity
the method of search which we
el to be fundamentally sound, and
the fact that the field of investiga-
on is large and essentially unex-
ored. We say that the field is
large because our microscope discovers a numerous variety of components within the coal substance, many of which can be conveniently classified in groups, so that utter heterogeneity does not exist. And the field is essentially unexplored, because of the limitations of our knowledge in regard to the nature of these physical components originally of plant origin.

(Applause.)

Chairman McFadden: Thank you, Doctor Leighton. In his customary and efficient manner, Doctor Leighton has presented to you a most comprehensive analysis of the research work so far accomplished as to the make-up of the coals we mine in Illinois. Are there any questions any of you want to ask Dr. Leighton at this time? There being no response to the question, the Chairman said: If not, we will proceed with the next paper, by Mr. Paul Weir, Vice President of the Bell & Zoller Coal and Mining Company, Centralia. I wish to say that I think probably most of you know that Mr. Weir has had quite an important part in representing Illinois in the making up of the Code as it applies to Illinois, and if all of you do not know, I want to tell you, that he is the party who coined the word "technician". That is one of the classes that are exempted from the Code as it applies to the mineral industries. So far, we have not been able to determine what a "technician" is. Perhaps Mr. Weir is going to tell us the definition of that word in his paper. Mr. Weir is still working with some of the Illinois operators in Washington, and his paper will be read by Mr. E. L. Berger.

THE COAL CODE

By PAUL WEIR
Vice-President, Bell & Zoller Coal & Mining Co.

Sometime ago our Program Committee asked me to speak briefly before the fall meeting of the Illinois Mining Institute on the Coal Code. Inasmuch as I was in Washington during most of the time this code was being written and consequently am aware of the fact that there is available sufficient material for a sizeable book for the events of each and every day from early in June until the present time, I attempted to obtain from the committee ideas which would limit to some extent at least, the scope of anything I might try to say. The consensus of opinion was that I should try to tell you things which would be of interest to practical mining men such as you and might be helpful to you in cooperating with the National Recovery Administration in fulfilling the purpose for which it was created.

For many years the coal industry has been held up by politicians, economists, bankers, educators and others as a very bad example of poor management and poor organization. It has been a football for outsiders and a football game without rules except those of the jungle for those two insiders—the miners and the operators. Miner was playing against miner, and operator against operator, as well as miners against operators. The acute depression of the past few years intensified the fierceness of the game. Many miners and many operators became casualties. It developed into a death struggle from which none could escape. While this description specifies the coal industry, practically all other industries in the country have been experiencing the same difficulties since 1930. The need for a set of rules for such a game is obvious. The differences between miners and operators and between the operators themselves had become of such proportions that they seemed impossible of reconciliation. A rule maker in the form of the Federal Government was provided when the National Industrial Recovery Act became a law in June of this year.

The basic ideas upon which NIRA was formulated are not altogether new. Perhaps you will be interested in some of the legislative efforts in behalf of the coal industry during the last decade and before NIRA. By act of Congress, the United States Coal Commission was created in 1922. In its voluminous report published in 1925, it recommended a form of governmental intervention to assist in placing the coal industry on a sane basis. Congress took no action on these recommendations. In 1928 Senator Watson of Indiana introduced in the United States Senate a bill which provided for governmental regulation of the coal industry. Hearings were held on the bill by the Committee on Interstate Commerce, but it was not given consideration by the whole Senate. In 1932 the Davis-Kelly bill came up for consideration before the Senate Committee on Mines and Mining. During these committee hearings the Hayden-Lewis bill, patterned after the British Coal Mines Act of 1930, made its appearance. After the present national administration came into power on March 4, 1933, a special session of Congress was convened by the President. One of the first bills introduced at this session was the so-called Black or 30-hour bill. While the

Watson, Kelly-Davis, and Hayden-Lewis bills were for the coal industry only, the Black bill was for all industry. The hearings on this 30-hour bill brought forth the best thoughts of industry and labor on the things which should be done or which might be done to start re-employment of the idle 10,000,000 wage earners, to increase purchasing power of the Nation, and to start the wheels of industry turning. The proponents of all these bills were considered as being friendly to labor They sought primarily to improve the lot of labor by shorter hours and higher wages. The Watson, Kelly-Davis, and Hayden-Lewis bills did permit collective marketing action by the operators. On the side of industry, the Walsh bill introduced by Senator Walsh of Massachusetts in May, 1933, was designed to permit prejudging by the Federal Trade Commission of marketing practices. This, in effect, was to set aside some of the rigid provisions of the Anti-Trust Laws and permit all industries to discuss destructive competition in a constructive way without being threatened with jail sentences. These various legislative efforts undoubtedly paved the way for Senator Wagner's NIRA. Labor wanted wage-slashing stopped. Industry wanted destructive price-slashing stopped. President Roosevelt wanted re-employment for 10,000,000 men and women. In the light of the emergency it seemed wise to give industry and labor the things for which they were contending when these very things showed every promise for returning people to work. Labor conceded the elaxation of the Anti-Trust Laws and industry conceded shorter hours and higher wages, together with collective bargaining. Governmental agencies were to be the referee and a Code of Fair Practice was to be written for each industry. Instead of a football game in which every man made his own rules, there was to be a game with definite rules for all participants and the rules were to be enforced by governmental authority. Instead of chaos there was to be orderly procedure and the unfair players, or chiselers, were to be eliminated if they failed to observe the written rules. Such is the plan of NIRA. In less than five months weekly hours of labor have been shortened, wages have been raised and 3,500,000 unemployed returned to work.

The first step taken by coal operators in the formation of a code of fair competition came on June 5 before NIRA had actually become a law. From that time until President Roosevelt approved the code on September 18, life for coal operators was just a continuous series of conferences. There was no great difficulty in getting the operators to agree on fair practices in the marketing of their product. The difficulty lay in formulating new wages and conditions of work in an area which contributes about two-thirds of the Nation's production but which for some years had not practiced collective bargaining with their men as we know it. Eventually the wage scales and working conditions in Illinois were used, in a large measure, as a basing point and comparable wages and working conditions were established in all producing areas. Thus, to a large extent and for the first time in a decade, Illinois is now on a reasonably fair competitive basis as far as wages and working conditions are concerned.

The Coal Code is the book of rules for the industry. It can be revised or amended by Presidential action. Contrary to the opinions of those who fought against the adoption of any code, this Coal Code contains a minimum of governmental regulation and interference. Anyone who has even a passing knowledge of the coal industry knows the difficulties in reconciling the views within an industry so widely spread geographically and so highly competitive from within and without. Differences of opinion between operators are difficult to adjust. Many times they are left to wear out to the detriment of everyone. Some outside influence is invariably necessary to effect even a compromise. The code provides this outside influence in the NRA. A Coal Code is one problem and the administration of that code is another problem. A good code might be ruined by poor administration and a poor code might even be helpful if judiciously administered. The present code is becoming increasingly popular. The staff of the NRA is sympathetic to the problems of the industry and is anxious to have coal settle its own difficulties in the manner provided in the code. The NRA is closely observing the operation of the code. If the industry can govern itself, there is every reason to expect that it will be left to do so. If after a fair trial it becomes apparent that it cannot, we may look for more government in our business.

Much of the difficulty in applying a code to an industry lies in the efforts of many in the industry to find ways and means of getting around the provisions of the code. If this same energy were devoted to wholehearted planning of ways and means to comply, a better situation would obtain. The whole purpose of the code is to put the production and marketing on an absolutely fair competitive basis. It is not designed to take away from the efficient and give to the inefficient. Its measure of efficiency is not sharp practice and unfair methods.

Every operator now has a book of standard rules. His operating personnel must realize that to survive they must hew to the line and develop efficient methods and produce a superior product. Wage-slashing is no longer a measure of efficiency. Price-cutting is outlawed as a substitute for efficient sales.

The coal industry in Illinois has reached a turn in the long hard road. A wonderful opportunity for regaining lost markets exists. Full advantage taken of this opportunity means a prosperous industry in this State. Illinois must offer to its coal customers the very best in preparation. Superintendents, mine managers, and miners must realize that only by careful attention to everything that influences quality can full advantage of our opportunity be obtained. To regain customers which have been lost to Illinois, we must give them better values than they have ever received from us.

There is nothing mysterious to Illinois operators in the labor provisions of the code. For almost forty years these same provisions have been in the making in our contractual relations with the miners. Only as modified by the code are our present agreements with the miners changed. There are some differences of opinion as to what the term "technicians" includes. This is a matter to be passed upon by the NRA or its designated agency. Our present labor contracts provide for 48 hours weekly of mine operation. The code provides for a maximum of 40 hours weekly for the individual employee. There is no conflict here. It is generally agreed that if any operator wants to operate his mine on a 48-hour schedle, he may do so by taking on an dditional complement of men and taggering their work days so that e has a full crew each day but so hat no individual works more than 0 hours weekly. In general, emloyees exempt from the jurisdiction f the miners are likewise exempt rom the restrictions of the code.

The daily press is voicing much pposition to the certain features of ie NRA. Time alone will tell whether heir criticism is justified. It is variusly labelled at times "The Two-ear Plan", inferring that it is Comiunistic or Russian. Perhaps it is ot out of place to point out that the ussian Planned Economy is designed o stimulate production to take care f consumption. Our problem in the nited States is to curtail production n an orderly manner without detructive wage-slashing and pricelashing, so that it meets the conumption demand without having an normous surplus.

It seems almost foolish to specuate on the permanency of the NRA. t does have a definite appeal to most hinking coal operators. Many opertors who opposed it are now giving t wholehearted support. They feel hat its good points outweigh its bad nes. It does seem certain that after he years of chaos, no one in the inlustry or out of the industry will vant coal to sink to its recent low lepths. The future of the industry till rests largely with the operators nd miners. Close cooperation beween them with the aid of the govrnment can place our industry on a igh plane.

(Applause).

Chairman McFadden: Thank you, Mr. Berger. Gentlemen, you have ust heard Mr. Weir's very fine paper on the Coal Code as it applies to the nining industry in Illinois. Any discussion? If not, I think our President has a word to say to you at this time.

President Hamilton: Thank you, Mr. McFadden, for serving as chairman of the morning session. After the morning meeting started, we found one of our former Presidents had arrived. I see Professor Callen in the rear of the hall, and I understand he has something of interest to say, and I know you will all be glad to greet him.

(Applause).

Prof. A. C. Callen: Mr. Chairman, and the Four Horsemen:

Mr. Weir has been talking about a "football game" in his paper. Some of you may have heard that there is going to be one at Urbana tomorrow. We persuaded the business manager of the association to bring twenty-five tickets over here and he will be at the desk outside immediately upon adjournment (before the luncheon), and if anyone is interested in tickets for the Michigan-Illinois game tomorrow he will be able to take care of you. He also has a few tickets for the Northwestern-Illinois game to be played at Evanston and if anyone wants to get one here, he will be glad to take care of you. The price of tickets for the football game is $2.20. Tomorrow is "Dad's Day", and there will be a big bunch of fathers there. In the evening there will be an ice hockey game with the Black Hawks.

President Hamilton: Luncheon will be at 1:00 P. M. and we will convene again here promptly at 2:30. May I ask that we be prompt, as we have two extremely interesting papers to be read this afternoon which will probably bring out considerable discussion and we would like to start promptly? Luncheon tickets can be secured in the hall and also the dinner tickets, and inasmuch as the attendance today has somewhat exceeded the estimate made by the Arrangements Committee, will you be good enough to secure your tickets for the banquet immediately after we adjourn so that we may get a definite idea of what the attendance will be, because we want to prepare enough seats for everyone for this evening?

There will be a meeting of the Executive Board immediately after noon adjournment and before lunch. Fearing lest your memory does not serve you correctly as to the personnel of the present Executive Board, it is comprised of:

Geo. F. Campbell
Paul Halbersleben
E. H. Johnson
Geo. C. McFadden
John G. Millhouse
Fred S. Pfahler
C. J. Sandoe
John W. Stedelin
H. H. Taylor, Jr.
T. J. Thomas
Paul Weir

and I ask that they come up here for a short meeting.

Mr. Geo. C. McFadden: I would like to make clear the request to get your dinner tickets at the same time that you get your luncheon ones, making it possible to count accurately the number of seats we will require. I also wish to express to you my appreciation of the attention you have given the papers this morning.

President Hamilton: There being no further business at this time, the meeting is adjourned until 2:30 P. M. Luncheon at 12:30.

Adjournment of morning session.

Meeting of Executive Board.

LUNCHEON

for members of the Illinois Mining Institute at Hotel Abraham Lincoln at twelve thirty.

Luncheon was served to those members of the Institute and guests who desired to partake of it.

The musical program by Messrs. Sheehan and Roche was enjoyed by all.

The speaker provided for the noon function was unable to be present, and President Hamilton expressed his regret, calling upon a popular member of the Institute to make an informal address.

HARRY FISHWICK responded in his usual happy manner, speaking extemporaneously on "Current Events in the Coal Mining Industry."

(Applause).

After the conclusion of the meal and entertainment the members gathered in groups around the hotel, renewing old acquaintances and making many new ones, until time for the afternoon session to begin.

AFTERNOON SESSION

of Illinois Mining Institute, November 3, 1933, 2:30 P. M.

After lunch and a short period for social amenities, the afternoon meetting was called to order by the President at 2:30 P. M., whose opening remarks were as follows:

President Hamilton: As Chairman for the afternoon session, I am honored and privileged to introduce to you an ex-President of the Institute, Fred S. Pfahler, of the Superior Coal Company, Gillespie. (Applause).

Mr. Pfahler (rapping): The gentlemen will please come to order. I do not know why the President wants to shirk his responsibility and unload me on this audience.

The first thing on the program this afternoon is the big entertainment feature which should have been shown at the luncheon. We will have the lights out, please. (Lights are turned off.) In the rear of the hall the lights were still burning and the Chairman called out to know if there was an electrician in the audience. Someone remarked: "We've burned out a cable." Finally, everything being arranged to the satisfaction of the operators of the machine, a sound motion picture was thrown on the screen behind the Chairman's desk, which was announced as a sound picture built by Edwin C. Hill, famous radio and newspaper star reporter, entitled, "The Dramatic Story of Preformed Wire Rope."

These pictures were claimed to demonstrate the greatest basic improvement in wire rope construction of this century. Many pictures of the development of the new wire rope were thrown on the screen and in contrast were shown pictures of the old type, much frayed and worn. It was claimed that this new preformed wire rope would save untold thousands of dollars to operators, in shop, mine, factory and projection work and that it would eliminate the costly, destructive stresses which cut down the life of ordinary wire rope.

The movie was received with much interest and hearty applause at the close.

Chairman Pfahler: I am sure everyone present has enjoyed this very interesting talking movie and we thank you very much.

Is Mr. T. J. Thomas in the audience? (No response). Will someone please see if he is standing outside and tell him that Mr. Budd is waiting for him down in the lobby?

The first paper on the program this afternoon will be on "The Preparation of Coal for the Market by the Dedusting Process," by Thomas Garwood, Engineer, C. W. & F. Coal Company.

THE PRODUCTION OF COAL FOR THE MARKET BY THE DEDUSTING PROCESS

By THOMAS GARWOOD

Orient No. 2 Mine, C. W. & F. Coal Co.

West Frankfort, Illinois

The production of coal for the market by the dedusting process has been in evolution for several years. The desire of combustion engineers for ideal operation in any boiler plant demands that the fuel with which the fires are fed be of uniform quality. This might mean that the analyses have reasonably constant values for ash, sulphur, moisture, clinkering qualities, ash fusion characteristics, etc., or it might mean that the sizing be consistently uniform. At any rate the engineer might be expected to get better results and higher efficiency from the boiler plant when conditions are normally constant and of known values.

It has been the ambition of combustion engineers for several years to produce a coal for the market that might be uniform in sizing and that each car of coal shipped to a customer would be uniform throughout the entire length of the car, with the minimum quantity of dust in the coal, and that each car be identical to the last one and to the next. To this end we have been experimenting for several years.

The problem of dedusting coal has gone thru a long trial at our mine and many methods of removing the dust were tested in our early experimenting. While there has been dedusting equipment in existence for a number of years in England and other European countries, this equipment was designed primarily for the removal of the dust causing washing troubles and sludge problems and did not fulfill the requirements that have been set up by our combustion engineers to produce a sized coal. The development of an entirely different machine at our mine resulted, and a small unit was put into operation about three years ago for experimenting and determining the value of such a product on the market. The difficulties in controlling the size of dust removed, with a minimum loss of the larger pieces, were many and the products which we desired necessitated a screening to relieve the dedusting equipment of large particles of coal. It was found by screen analyses that the amount of dust in the larger sizes of coal was insufficient to warrant any attempt of its removal. Our small experimental machine for dedusting the Carbon coal had a capacity of only four or five cars of the finished product per day and the ability to make, by combination, two grades of small coals each with the dust removed. The production of these coals was continued for about two and one half years or until it was established that the commercial success of such a coal was possible and that the demand for this type of product would justify the installation of a larger unit. This large plant has been built and placed in operation with gratifying results. We are now supplying a growing market and expect to have in the near future, comparative data from boiler plants using the new dedusted coal as against the natural run of mine screenings.

Ordinarily, the production of screenings at any mine is a variable proposition. With different sizes of coals coming from the mine at different times and the dumping of an occasional car of undercuttings with its high percentage of fine dust, the production of a mine run screenings with a constant low portion of dust is obviously an impossibility.

It was found that the different methods of mining might increase the percentage of lump and that rougher handling would make a greater percentage of screenings but that in the screenings themselves the character of the smaller sizes and of the fines remained unchanged. It was then decided that this character of screenings with respect to the objectionable dust would not be changed by modifying methods of handling or mining and that to produce a coal commercially with a minimum amount of dust would require a mechanical treatment in the tipple such as our machine was doing successfully.

Since this machine is designed to treat the carbon size of coal and inasmuch as one large enough to handle our entire raw feed of screenings is impracticable, it is necessary to separate the carbon from the other sizes and after removing the dust replace the dedusted carbon in the larger size mixture to make a dedusted screening. This mixture is made as the coal is being loaded into the railroad cars. When sized coal is being made in the rescreener the products of the deduster may be loaded directly as an ideal fuel for small stokers.

Natural screenings, composed of all pieces passing thru a specified screen down to and including the dust, are mixed in such a way that the smaller pieces fit into the spaces between the larger sizes and the dust which fills the smallest openings finally blocks the air passages thru which drafts should pass in the process of burning the coal. By removal of this fine dust these passages remain open and air for combustion can get to all the pieces of coal on the grates. In the natural screenings, with their uneven mixture air might travel through one section of the fire bed leaving other parts of the fire bed to coke, the first being burned quickly leaving air holes in the fire bed. The increased uniformity of the air distribution through the fuel bed results in better efficiency and greater economy. The possibility of forcing greater quantities of air through the fuel bed will permit carrying a greater load on the boilers at peak demands without the trouble ordinarily occurring from clinkering. It is difficult to wet natural screenings quickly, due to the seal caused by the fine particles and their greater capacity for holding water. However, with the dedusted coals, wetting can be accomplished in a short time with a minimum of water; either in the pile, on the truck, or on the railroad car. The little dust that is formed in transportation is thus easily prevented from blowing about.

Aside from the convenience then the outstanding advantages in the use of the dedusted coals are:

1. Improved efficiency due to more uniform flow of air through the fuel bed.
2. Less clinkering.
3. Increased load capacity during peak demands.
4. The coal is easily dampened before used in the boiler rooms.

One long time test showed that the load on one boiler room could be carried more efficiently with dedusted Carbon than with natural screenings, while the natural or un-dedusted carbon could not be burned in the plant, even without load. We believe we will soon have data on the burning of dedusted screenings that will be comparable to this test.

(Applause.)

Chairman Pfahler: Thank you, Mr. Garwood. Has anybody here any questions they want to ask Mr. Garwood?

No one had any, apparently, and Chairman Pfahler said: What's the matter with you fellows? Don't you know anything about dedusting coal? Or perhaps you know all about it? (Laughter).

Mr. D. R. Mitchell: What percentage of dust is left in your product?

Mr. Thos. Garwood: Well, it varies; — ordinarily about 14 per cent. I would like to say that so far, the main trouble we have had is that boiler plants are not ordinarily equipped to handle dust. (Here he went into an explanation of how plants could be changed to burn the dust).

Chairman Pfahler: Any other questions?

Mr. H. F. Hebley, Engineer, Allen & Garcia Company:

I think the C. W. & F., Mr. Garwood and his associates, deserve a great deal of praise for their pioneering in dedusting work. For several years we have been conducting dedusting tests from time to time, and in testing of coals for the removal of dust sixteen tests on five different seams from the Illinois-Indiana and West Virginia fields show that with a feed of ¾″x0″ slack, two fractions are generally formed in the following percentages:

Coaldust	10-15%.
Dedusted Coal	90-85%

When attempting to separate at 48 mesh, the per cent of 48 mesh left in the coal varies from .75—3%, depending on the moisture in the feed. The per cent of —48 mesh in the dust extracted varies from 75 to 93%.

Coals that contain thin laminated pieces generally cause trouble, as these pieces lift like a leaf in the wind and tend to sail.

Coals that contain fine particles of pyrite require an adjustment to be made for the difference in specific gravity, of pyrite and fusain. Assuming a specific gravity of

—2.4 for pyrite and
1.4 for fusain

the velocity of the aspirating air for lifting the heavier pyrite particle will often lift a larger particle of light coal.

There is a distinct drying effect of air when it is used for dedusting. In one test the moisture content varied as follows:

Moisture in raw coal	15%.
Moisture in dedusted coal	12%
Moisture in dust	8%

Dr. Cady's paper pointed out that Illinois coals contain a concentration of fusain in the —100 mesh. He also pointed out that the fusain ran high in ash, high in moisture and high in carbonization.

The disposal of the dust—a quantity ranging from 10 to 15% of a mine's ¾″ x 0″ screenings production is a serious problem, but can be solved.

Burning this dust under boilers without further regrinding has been accomplished and 80% efficiency has been attained.

At the present time in Indiana there is one plant burning coaldust from dedusting equipment, but further pulverization has been adopted.

Within the last month or so we have been carrying on research investigating the possibility of rearranging the present low set hand fired horizontal return tubular boilers generally installed at coal mines to burn the dust without further regrinding.

After some disappointments, we have discovered a burner designed primarily for use in the very restricted furnace flues of marine and Lancashire boilers.

With this burner HRT boilers set 3′ 6″ above the grate can be arranged to burn the dust and still keep the hand fired grates in place to burn ROM if the dust supply fails. The design data for such a rearrangement on a 150 H.P. boiler is as follows:

Vol. of Com. chamber	900 cu. ft.
BTU release (cu. ft.) hr.	9,500
Flame travel	26 to 30 ft.
Burner fishtail grid type.	
Prim. air	13-15%
Sec. air	40%
Tert. air	45%
Furnace temp. 1700-1900 degrees F.	
CO-2	8.0%

The CO2 is deliberately held low to insure the ash being held below the fusion point. Efficiency has also been kept low as the problem is at the present time one of dust disposal and the destruction of the dust under the boilers serves a two-fold purpose—provides heat and eliminates a dust nuisance.

However, the efficiency can be readily increased if desired by reducing the excess air, provided the high resulting furnace temperatures do not set up troublesome slagging conditions.

Chairman Pfahler: Thank you, Mr. Hebley. Has anyone else any questions?

President-elect Treadwell: We might be interested to know that some of the stoker manufacturers are trying to utilize this grate. They have made some careful tests using their stoker and they are willing to make tests on the corrected results. That is of interest because most of us fellows who have been trying to utilize this dust have run into pulverized fuel, which means a rather high cost. However, these stoker people claim that they can burn this dust in their stokers with very few changes.

Chairman Pfahler: Any other questions?

Mr. Johnson: I would like to ask Mr. Garwood if the percentage of ash in the separated dust is higher in southern Illinois than in northern?

Mr. Garwood: It would be somewhat higher.

Chairman Pfahler: Is Mr. J. I. Thompson of the Koppers-Rheolaveur Company of Pittsburgh here? I would like to hear from him on dedusting coal if he is in the audience.

Mr. J. I. Thompson: I do not believe that I have anything much to say. The only thing that might be of interest to you (and some of you already know it) is that we have built a small separator with which we have tried to carry out all the principles of a full-sized plant. This separator can be fairly easily handled and put into a plant. It is about 8 or 9 feet high, 5 or 6 feet wide and 7 feet long. We tried it out in one of the plants of the Peabody Coal Company. That separator was handling 1½"x2.0" coal, but the results are not yet available. We had some difficulty in feeding 1½"x2.0" coal (as one of the other stoker people has mentioned). That is due to the openings not being large enough for the larger-sized coal.

We are putting some additional apparatus on our equipment and we hope to be able to get results on the larger sizes. This equipment is available now, and, under the experiments we are making, it would apply on any coal.

One of the difficulties that we have run into in separating coal—and one of the difficulties that the Chicago, Wilmington and Franklin people have tried to overcome, is the fact that in fine coal the moisture content is greater in the fine sizes. In other words, the fine sizes are much wetter than the coarse stuff, and we found that there was a big tendency for the dust to go on through the larger particles of coal. After they were put in the cars and shipped and dried, these particles of dust would fall off, but the coal as obtained from the mine after dedusting seemed to be quite free from dust. Perhaps this was caused by a dry atmosphere.

I do not know that I can add anything more at the moment, but if there are any questions any of you would like to ask, I will try to answer them.

Chairman Pfahler: Thank you, Mr. Thompson.

Mr. Johnston, I understand your company has been making some experiments along this line. Can you tell us anything about them?

Mr. J. M. Johnston: Our experiments have been on a small scale, and, so far, our plant is still on paper. Therefore we have no results to offer from our dedusting. We are going to try and burn our dust in our own plant, but whether we will accomplish this on the type of stoker we are using at present, I do not know. We have tried burning some of our dust, with more or less good results, and we have tried burning it mixed with other fuel, but we found that when mixed with other fuel, it would pack and of course we could not get a good fire. We have also tried blowing our dust and we found that by keeping a good bed of coals on the grate we were able to burn the dust. But our plant (as far as dedusting is concerned) is still on paper and we have had no results from it.

Chairman Pfahler: Thank you, Mr. Johnston. Has anybody else anything to say or questions to ask Mr. Garwood? (No response).

The gentleman who is to give our other paper this afternoon is a little bit late. He 'phoned from Centralia. He had to come all the way from Benton, but he will be here in a few minutes. President Hamilton wants to make some announcements at this time.

President Hamilton: At the morning session you authorized the appointment of two committees. A meeting of the Executive Board was held immediately after the morning meeting and these committees were selected. I will now ask the secretary to read the names.

B. E. Schonthal, Secretary: The Special Committee on Scholarship is:

Charles F. Hamilton, Chairman.
J. M. Johnston.
H. H. Taylor, Jr.
George F. Campbell.
L. D. Smith.

The Special Committee on Resolution to be sent to Washington to try to secure an appropriation from the Government to further Mineral Industries Research is as follows:

George N. Reed, Chairman.
Paul Weir.
T. J. Thomas.

Chairman Pfahler: Anybody else anything to suggest while we wait for Doctor Moore, or anything of interest to say? We would be glad to hear from anybody. (No response).

Chairman Pfahler: Is there a man in the room who has not been asked to join the Illinois Mining Institute? If so, do not be backward in saying so. The Secretary here, or the registration people out in the hall, will be glad to take care of you.

While I am on my feet at this time I think it would be well to announce again that the banquet will be at 6:30 sharp. We were very fortunate in securing a very prominent, outstanding railroad man, Mr. Ralph Budd, President of the C. B. & Q. Railroad, to be our speaker tonight, so we would like to get started as near 6:30 as possible, and we will appreciate it if you will be on time.

Has anybody anything else to say? What's the matter with John Garcia? Is he asleep? Oh, I see—he has disappeared.

George F. Campbell: Might I suggest that we recess for fifteen minutes or half an hour and come back here then?

Chairman Pfahler: Well, that would be a good suggestion if I could be sure you'd be back here, but, after a recess, it is rather hard to get the men back, once they have left the hall. The Doctor ought to be here any minute; but, George, we are not going to let you sit down by just making a suggestion that we recess. Can't you say something of interest to us?

George F. Campbell: Well, I have enjoyed this Institute very much and hope to enjoy a lot more before I get through, and I hope that the evening session will be as pleasant as the morning session and this one.

Chairman Pfahler: Thank you. I can vouch for George as a good bridge player. If anyone wants any instruction in the game, they can go to him.

The President suggests that I ask you to stay right here, as he apparently concurs in my thought that if we were recess for thirty minutes you might not come back.

Mr. A. W. Plumlee: I would like to suggest that a true copy of Dr.

ady and Dr. Leighton's paper and ictures be put in printed form. This only a suggestion—not a motion.

Chairman Pfahler: We will be lad to consider your suggestion, Mr. lumlee; however, they will appear full in the Year Book. (President, hairman, and Secretary consult.)

Now, gentlemen, we have had a hange of heart and change of mind. believe George Campbell's sugges-on is pretty good, as I see that a umber of you are beginning to drop ut by one and two at a time and ather than have that happen to Doc-r Moore, we will stand adjourned ntil 4 o'clock.

Adjourn to 4 P. M.

Afternoon Session reconvened at o'clock. Chairman Pfahler, rap-ing for order, spoke as follows:

May I ask the people in the hall please step back into this room? When everyone was seated and silence was restored, he continued:

The next paper will be by Doctor J. B. Moore, of Benton, Illinois, whom I now take pleasure in introducing to the Institute. (Applause.) Doctor Moore's subject will be:

"THE RELATIONSHIP OF THE INDUSTRIAL SURGEON AND THE EMPLOYER OF MEN"

Dr. J. B. Moore: I am a little bit surprised at the hearty greeting I got after delaying you for so long. You know I am not bragging, but it takes a lot of nerve to talk to an audience like this. I can talk to a lot of doctors with much more ease, but I have never tried to talk to a group of engineers before, and, in order to stay on my own side of the fence, I am going to stick strictly to the notes I am going to read.

THE RELATIONSHIP OF THE INDUSTRIAL SURGEON AND THE EMPLOYER OF MEN"

By J. B. MOORE, M.D.
Benton, Illinois

I think that you will all agree with e that the interests of "The Indus-ial Surgeon and the Employer of en" arise from common ground, ntering in the injured employee. he general recognition that industry ould share the financial burden of ss of time and disability resulting om personal injury, has fused the rgeon with the other elements mak-g up an industry.

In recent years the surgeon has be-me an indispensible part of the al mining industry in Illinois. hat then should this industry ex-ct of him? It should expect aid the prevention and minimizing of injuries, and cooperation with the compensation department in the return of the men to work, and in the final disposition of their cases.

The intelligent and persistent instruction of the employee in the care of minor injuries is quite important. The "Skinned Shin" which occurs so often, is many times the cause of much loss of time. The injury is not serious as to the final outcome, but the payment of temporary compensation is a very large item in the course of a year.

The workmen generally consider it of such minor importance that they neglect to report it until it gets sore, two or three days later. In the meantime the clothing has thoroughly infected it. I have seen such cases resist treatment for weeks. They should have immediate attention.

Toe injuries are very common in the coal mine. The conditions are ideal for this to happen. Some of us have seen this type of injury almost disappear in territories where a shoe with a protective tip is worn.

All of you are familiar with the dangers of having a fellow workman attempt to remove a foreign body from the eye, or of putting it off until tomorrow. But this information must be driven home to the men in the works, if it is to be of any use. The surgeon can help to do this through cooperative efforts. I think that the surgeon should come in contact with the men in some capacity other than through the necesary care of an injury.

There should be friendly, trustful cooperation between the surgeon and the compensation department. Free and honest discussions of their problems is essential to an efficient organization. There should be no "Buck Passing".

The compensation department has a right to expect a prompt accurate report of injuries, prompt release when a man is able to return to work, and a plain statement of facts, in-so-far as the surgeon is able to do so, as regards the final condition. In the latter the surgeon should be firm but fair and sympathetic with the injured man. I think that he should not enter directly into the financial settlement of the cases.

It is very desirable that the surgeon maintain the good will and confidence of the injured employee. This can not always be done, but when possible it greatly facilitates the man's return to work, and an agreeable final disposition of the case.

Getting a man back to work is many times one of our most difficult tasks. Lack of cooperation between the operating and compensation departments is too often "The Nigger in the Woodpile". For consideration—suppose we are dealing with a trip rider, who has received a broken ankle. After three or four months he is able to do some kind of work, something that will cause him to use the injured part more than when he is at home, and that will help to regain its use and establish him on a work basis. It may be several months before he is able to return to his original job, never-the-less the operating department insists that he be kept out until he is able to ride trips again.

Suppose a man has been off several months on account of a serious back injury, eventually it is agreed that he is able to do some work. This type of case progresses just so far and no farther until they return to some kind of employment. The rehabilitation is slow, but if managed properly, he will be able to return to loading or his machine. He is discharged for work and taken off compensation. The operating department immediately puts him back in a machine gang where the men share equally in the earnings of the group. It is soon quite evident, that he cannot do his part of the work. The other men complain, and he returns in one or two days discouraged and convinced that he will never be able to do heavy work again. He demands to be placed back on compensation, and whether he is or not, he becomes a more complex problem.

Now, suppose that these men are placed in a "Rehabilitation Squad" to do some odd jobs in the mine. Cleaning up falls, cleaning roads, etc., under a firm, but sympathetic understanding supervisor. They will be kept in the squad for a few days, or eeks, as the case may demand, when ey are put back in their old places at some regular job. I believe at this plan would be well worth hile, not only as regards the indi- dual, but to reduce compensation r injuries.

The surgeon should expect loyal pport from the industry that he ay be serving. In the smaller com- unities I think it is mutually ad- ntageous for the company doctor do some general work. It helps to stablish him with the public, and ere should be no conflict.

It must have occurred to you that e surgeon's real service is rendered a time when the employer and the nployee are in complete agreement, d demanding the same thing, viz: e quickest and the most complete covery.

(Applause).

Chairman Pfahler: Thank you, octor Moore, for your very inter- ting paper. Does anybody want to k Doctor Moore any questions?

C. J. Sandoe: I would like to ask e doctor how much first aid should given at a mine to men who are be sent to a doctor—or should the en stay away from a doctor?

Dr. J. B. Moore: Well, you know, at is quite a problem. I have seen number of complications from too uch first aid in the mine. I know at a few years ago, in many States, ncture of iodine was distributed in rst aid stations in the mines, as it as in Illinois till we had some ter- fic burns from it. Some people are ry susceptible to iodine burns; in ct, most people are susceptible to dine burns, and I think iodine ould be very carefully used, if at l, for dressings. I think first aid, rticularly in the southern Illinois rritory mines, should be confined to stopping blood where there are hemorrhages—and temporary slings for broken legs and arms. I think there should be no attempt to use anything in the way of dressings except the most simple type of dressing, with nothing in it on the order of tincture of iodine that might cause trouble or burns. In fact, we are getting away, more and more, from dispensaries around the mine or home.

Chairman Pfahler: Any more questions?

Mr. John A. Garcia: I would like to say something on this question of accidents around coal mines. It is my experience that we keep pounding first aid all the time into the bosses, superintendents, mine managers, etc., all down the line,—but we never get to the fellow who really gets hurt, the worker (so-called.) We call meetings among the bosses and discuss the question—and we put certain rules in force—but I do not know of any place that we have ever called the so-called worker into our meetings and discussed accidents around the mines. For the last ten years I have been gathering reports and bulletins from the different coal companies, like Bell and Zoller, Union Pacific, and different companies who issue reports as to how the accidents happen—and I study them, not only because I am interested in coal mining accidents, but for my own good, so that when I go around a mine I will have learned from studying these reports just how men get injured. This I know is a selfish motive. But I do not know but what it would be a very good idea for the Illinois Mining Institute to collect these statistical bulletins issued from time to time by various coal companies and the Bureau of Mines, and send them directly to the men who actually do the work in the mines—to the men who may get killed or hurt.

We operate a little mine down in Indiana and every time a man is injured we either publish a bulletin or post a notice on a bulletin board, giving the details, so that the men will know just how the accident happened—and with the help of the Bureau of Mines, we have collected this data and put it in a conspicuous place at the mine so that the men can hardly resist seeing just how these men got hurt.

We have our meetings once a week down in Indiana on accident prevention, but no one ever comes to those meetings except mine superintendents, foremen or bosses,—and after you have done that for two or three years, your organization gets saturated with your attempts to prevent accidents. What you have to do is to get this to the fellow who is running a motor—a triprider—and the men who usually suffer these injuries.

The Bureau of Mines and all these different State organizations have done their best to educate people in the safety movement,—but they do not get down to "brass tacks" and educate the man who earns his daily bread with the sweat of his brow as to how these things occur.

I have perhaps saved my life at times in traveling around mines, by what I have learned reading about how accidents happen to the other fellows. There is some co-ordination or cooperation amongst the operators of mines in the middle west and I think it would be a mighty fine thing for the Illinois Mining Institute, through the Bureau of Mines, to cooperate and get the details of these accidents and post them at the different mines so that the men themselves can find out how their own fellows get hurt.

Chairman Pfahler: Thank you, Mr. Garcia. Anyone else wish to discuss this matter?

Mr. Berger: In our own properties, we issue these bulletins, and we see that they not only go to the bosses, but to every man. We distribute them right with the pay-checks. Every man is offered one of these, and he can see (as Mr. Garcia said) just how the accidents happened.

We also sometimes have an artist draw a picture of how an accident happened, and post it in a conspicuous place for the attention of the men, and it does attract attention. But a poster must not stand in a place indefinitely, as it loses its appeal. You have to change them frequently in order to draw the attention of the men to it.

I think there is a gentleman here, Mr. Alex Miller, of the Bureau of Mines, who has been going around giving first aid and safety first lessons, (which is a fine thing,) but our experience has been that when the gentleman did come and put over first aid lessons, he talked accident prevention to the men themselves and in that way they reached everyone, and we have got very much better cooperation from our men than we ever expected we would get from men of that kind.

Chairman Pfahler: Anybody else anything to say?

Mr. Alex Miller, Associate Engineer, U.S. Bureau of Mines: I can verify the statement of Mr. Garcia, as far as accident reports are concerned. I have had the privilege of making a survey of thousands of accident reports in the past few years, and I want to say that I do not believe I have run across any that gave any information pertaining to the CAUSE of the accident. Practically each and every one stated WHAT CAUSED THE INJURY—but none of them stated WHAT CAUSED THE

ACCIDENT. There is a vast difference between what may cause an accident and what may cause an injury—the injury is only one of the products of the accident—and unless we get down and analyze the cause of the accident, it is self-evident that we are not going to get at real accident prevention. As far as reaching the miner is concerned, we have found that first aid is one of the best features of educational work in accident prevention that we have run across, because it brings to the mind of the individual the seriousness of accidents.

I attended one of those meetings Mr. Garcia spoke of, last Wednesday in Indiana, where there were one hundred and twenty-six people present—most of them miners. The superintendent of that mine had every report of accidents that had occurred in that mine for the month of October read before the meeting, and the men discussed the causes of those accidents, and suggested means of removing the same.

I think all the officers of an organization should be personally interested in accident prevention first—and then carry it to the men. I have ofttimes heard it said that you could not get cooperation from the men—but I believe that is a mistake, because I have seen some of the best cooperation in the State of Illinois that any person could hope to receive in any movement he might see fit to inaugurate. I think it is possible to put the causes of accidents before the men and get them to take a personal interest in holding future meetings for that purpose.

Chairman Pfahler: Anyone else anything to say? If not, we have in our midst a very prominent, outstanding coal operator in the State of Illinois with us today. If my memory serves me correctly, I believe this is the first time he has been at one of our meetings. He has been very active in modeling and remodeling the Coal Code and also in seeing that it functions properly. He has recently been in Washington—in fact, I believe he flew here to be at this meeting this afternoon. I take pleasure in introducing George B. Harrington, President of the Chicago, Wilmington and Franklin Coal Company:

George B. Harrington: Fellow Members of the Illinois Mining Institute: I am sorry I did not hear Mr. Weir's paper on the Code, because I fear that almost anything I may say about it is likely to be a "repeat". I know that there are a great many questions in your minds as to just what is the present status of the NRA, and, by the same token, the status of the Code. What I say will have to be more or less a personal opinion and not an authoritative statement, because I am going to give you a little of my own guess on the situation.

The Code (which was largely the work of Illinois operators assisted by men from other States who were already operating under Union contracts), had as its first object a standardization of wages and working conditions and hours within the various districts in the United States—and the reasonable standardization of these conditions between districts serving the same markets. We with Union contracts felt that we were under an unfair handicap and wanted to take this opportunity to get that handicap squared up. I do not need to tell you how through the depression our non-Union competitors were able to cut down to where they practically put the Union fields in the north out of business, and we all know that it was an unfair situation. The NRA gave us the chance to straighten that up and at the present time differentials between our field and the former competitive non-Union field are written in the Code. Having made a big drive on that, the Illinois people were not so insistent on their own ideas as to price fixing. I think it is safe to say that we all had various ideas, and that they were boiled down pretty much to a feeling that the companies are entitled to the cost of production plus a reasonable profit. However, during the spring, the Appalachian coal organization, which was based on the latest Supreme Court decision, had gotten a good deal of a start and the operators who were familiar with that had a good deal to do with writing the price-fixing part of our Code, which is based on the Appalachian idea. Price-fixing has been put into several other Codes, but some of the industries do not have it.

Speaking of some of the difficulties of NRA in getting organized:—Gen. Johnson promised that he would not have over one hundred and fifty men in the NRA. Within the past week the Republican National Committee have issued a pamphlet in which they criticize the Democratic Administration for many things, but among them they criticize the NRA saying it now has more than one thousand employees additional in the field—that they really have not got started yet—and when they get organized to carry out the numerous functions of the Code, it will be a large bureaucracy. These criticisms got under the skin of Gen. Johnson and he and Mr. Richberg have been in a series of conferences with the President as to how big this thing is going to be. I mention this because we have been wondering why we do not get our Presidential appointee for Illinois. The answer is that until the NRA decides how big it is going to be, they hesitate to make all these additional Code appointments. They have asked whether the coal industry would chip in and pay the expenses of these people. Most of the big groups said they would and the little ones said they would not, but it looks a little as if the industry would pay for the Presidential appointees. Then some of the fellows who said they would be willing to pay qualified that by saying that if they paid they ought to be allowed to pick their own representatives, and they all began sending in names. We have sent in the name of Doctor Honnold, whom you all know. He was put on the slate, and when that slate got up to Gen. Johnson it is said that either someone told him or he thought that "these industries are going to run things and fix prices and that will make a tremendous target for Congress to shoot at next January,"—so he turned down all of these appointees, and Doctor Honnold was disapproved among all the others. Then it was a great day for all the unemployed engineers. You know a great many very worthy engineers are out of work, so many of them applied for jobs, but none of them have been picked—but at the present time it looks as though most of those who will get jobs will be mining engineers or someone who knows something about the mining business. As you saw by the papers this morning and yesterday, some of the leading industrialists in the NRA have resigned; they have said they were not quitting but just going back to their own business—and the answer is that nobody knows whether the NRA will be organized into a permanent instrument to govern industry as they do now under the Code or hether they will try to contract hemselves to their original purpose, r as Mr. Swope put it, be somewhat ike a National Chamber of Commerce, and run themselves. I am ot much of a believer that the last s practicable.

So we have just got to be patient ntil they decide the policy of the NRA. Now that may not sound very heerful as to our Code but on the ther hand I do not think that Illinois tands to lose very much whichever vay this thing is decided.

The big thing we need out here is o play the same rules of the game as he other fellow—that is—to be able o work the men a certain number of ours at a certain rate of wage, and ctually pay the payrolls—and things f that kind. If we just had the Code nd the NRA blew up we might drop ight back into the old conditions; ut, in addition to the Code, we now ave the UMWA in districts where ormerly they did not exist, so that he mine workers are really in, vhether the Code blows up or not, nd I doubt if that will change for uite a while—so that from our point f view it is undoubtedly going o be of value in this district for a ong time to come, and for that I believe we are to be congratulated, that ve did take the position that if there s to be a Code that Code must apply o everybody in the industry. In other vords, we could not have a separate Code for West Virginia or West Kentucky, Indiana or Pennsylvania, and hen write our own separate Code—nd no one pay any attention to it. We got one Code for the whole industry—and I think that is very important.

I do not know whether I have helped larify anything you wanted to know, ut I will try to answer any questions:

Chairman Pfahler: Thank you, Mr. Harrington. Anybody else any questions?

Mr. John A. Garcia: I have been approached (an unemployed engineer —more or less employed) in connection with a technical matter in Washington—and necessarily I had to turn it down. I have quite an intimate acquaintance with each of the three technical advisors on coal mining in Washington, and I want to say that there is not in Washington a technical advisor who has any connection of any kind with Illinois and Indiana.

Some of the men, to my personal knowledge have never been in a coal mine themselves and that position of technical advisor in Washington is of very vital importance to the middle west. Instead of an eastern man sitting down there in Washington advising the commission on our problems in Indiana and Illinois I would like to suggest to the commission that we have now in both Illinois and Indiana, Mining Institutes and they can submit their problems in Illinois and Indiana to men from those Institutes rather than to some stranger, and I think it would be very wise for the Illinois Mining Institute to create a situation whereby any problems of our industry will be referred to one of those Institutes. (Applause.)

Chairman Pfahler: Before turning the meeting back to our President, I again urge you to be prompt at our banquet. Purchase your tickets at the registration desk any time before 6:30—and for the benefit of those who were not in the room before, I want to state again that Mr. Ralph Budd, President of Chicago, Burlington & Quincy Railroad will be our principal speaker tonight and he will make a very interesting talk.

I thank you gentlemen for being quiet this afternoon, making it easy for me to preside. I now turn the meeting back to Mr. Hamilton.

President Hamilton: Thank you, Mr. Pfahler, for your services as chairman of the meeting this afternoon. I have nothing more to offer to the Institute at this time except to again urge that your schedule be so arranged between now and 6:30 P.M. that you can be here promptly to start the banquet on time. It will not be of long duration and there will be ample time afterwards for the other activities I know you enjoy.

Is there any further business? If not, the Institute will stand adjourned until 6:30.

After the business session and the the morning and afternoon programs of the Illinois Mining Institute had been completed, the members adjourned until 6:30 P.M., when a sumptuous banquet was served in the gold ballroom of the Hotel Abraham Lincoln to the membership and friends of the Institute.

President Hamilton called the meeting to order and gave a brief resume of the work accomplished by the Institute during his term as President, which showed that it is in a very flourishing condition.

It had been arranged that the Honorable Thurlow G. Essington, Chief Counsel of the Illinois Coal Operators' Association, should serve as Toastmaster, but unfortunately other engagements prevented his being present. In his absence President Hamilton said that we were fortunate in securing the services of the Honorable Walter W. Williams, President of the Illinois State Chamber of Commerce of Benton, Illinois, to act as Toastmaster for the evening. With a very appropriate introduction, Mr. Williams was called upon to act in that capacity and in his own pleasing and efficient manner he very graciously accepted this responsibility.

After a few appropriate remarks concerning the Institute and the mining industry in general, the Toastmaster introduced the officers for the ensuing year and the members of the Executive Board, but in view of the fact that the program was lengthy, the incoming officers responded in an informal way.

Several distinguished guests were present at the banquet. Harvey Cartwright, Secretary of the Indiana Mining Institute and Indiana Coal Operators' Association, upon being introduced extended a very cordial welcome to the entire membership to be present at the Indiana Institute meeting to be held December 4th at Terre Haute. In a very able manner, Mr. Cartwright spoke of conditions as they exist in Indiana at this time, with particular reference to the NRA in that State. There were also presented to the meeting Mr. George B. Harrington, President of the Chicago, Wilmington and Franklin Coal Company, Dean Thompson of the University of Illinois, Mr. W. C. Hurst of the C. & I. M. Railroad, and W. D. Ryan of Kansas City, who, in his usual happy mood, spoke very enthusiastically of the work that had been accomplished by the Illinois Mining Institute.

Following all of these introductions, in a few choice words, Mr. Williams introduced the principal speaker of the evening, Mr. Ralph Budd, President of the Chicago, Burlington and Quincy Railroad, who spoke on "Some Personal Observations in Russia." (Applause.)

"SOME PERSONAL OBSERVATIONS IN RUSSIA"

By RALPH BUDD

President, Chicago, Burlington & Quincy Railroad

It is appropriate for a railroad man whose line participates substantially in the movement of coal from Illinois mines to meet with this group, and I appreciate the honor of being your guest on this occasion. Railway men and coal men ought to be interested in each other's success because each group is one of the other's best customers. Products of mines account for 55% of all the tonnage moved by the railways in the United States, and coal mines furnish the most of it. The Burlington gets nearly thirty per cent of its tonnage, and nearly sixteen per cent of its revenue from bituminous coal, and most of that is Illinois coal. We have been concerned, as I know you have, to see the percentage of total United States coal produced in Illinois decline very rapidly in recent years. The figures I have seen indicate a reduction of from nearly 17% in 1921 to about 10% at present. Let us hope that one result of the efforts to stabilize industry along fair competition lines may be to restore to the Illinois coal mines its former and, I believe, its normal position in the country's production.

We have understood your situation and I feel certain that I may speak for the railroads generally in saying that we appreciate the loyalty of your industry to the railroads. We are primarily vendors of service and our first duty is to provide the service that best fits your requirements. This we have tried to do and will continue. We may not be able always to meet your views entirely, or to comply altogether with your requests, but we shall always be glad to deal with any problem you may bring to us and will do so in a sympathetic way, knowing that our success to a large extent is inter-dependent and our purposes mutual.

It has been suggested that I tell you something about a trip through Russia. So much has been said and written about that subject in the last few years that I am afraid it has been worn threadbare. The pending conferences between our President and the Soviet's Commissar of Foreign Affairs may, however, make the subject of sufficient immediate importance to constitute an excuse for my narrative on this occasion.

All of you are familiar with the so-called Five Year Plan for industrializing Russia. It seems to me, after discussing their plans, that the expression "Five Year Plan" is a misnomer, because the planned economy which has for its primary object the extensive industrialization of what had previously been almost solely an agricultural country, extends over many more years than Five. The first fifteen years of the plan were quite definitely outlined when I was there in 1930 and these fifteen years had been divided into three periods of five years each. I think a more descriptive as well as more accurate expression would be "The First Five Years of the Plan", "The Second Five Years of the Plan", "The Third Five Years of the Plan", etc. However that may be it was the so-called Five-Year Plan which resulted in my going there, the purpose being to give advice concerning the improvement and rationalization of the Russian railway system, which by reason of the industrial program would be called upon to handle a much larger volume of traffic than it had carried previously. There were two views among the officials of Soviet Russia on the railroad question. One was that the roads should be Americanized and brought up to the standards of the railways of this country, and the other was that they should be improved to conform with the modern railway standards of Europe, having in mind particularly the German railways.

In order to base their decision on first hand information a commission of approximately twenty Russian railway men was sent through Europe and Canada and the United States to investigate and make a report on the matter. At the conclusion of this inspection trip early in 1930 the members of the commission decided that the railways of this country and Canada were more suited to the transportation requirements of Russia than the railways of any other country, but in order to check their own conclusions they wished the opinion of some American railway men. It was in response to this desire that five of us visited Russia in the summer of 1930 and traveled rather extensively over that country for the purpose of determining whether in our opinion American railway standards, methods, and practices are entirely suitable for Russian transportation requirements. It seemed to us that there were three primary factors to be considered. First, the topography of the country as to the practicability of lines with low grades and easy curves; second, the climatic conditions; and, third, what may be termed the railway duty of the country, that is, the character of commodities to be handled, the density of the traffic, the length of haul, etc. We were in Russia 73 days and inspected most of the large terminals and most of the important traffic routes, covering some 17,000 miles of a total of about 50,000 miles of railway in the country. Entering Soviet Russia through Poland, a fourteen hour ride brought us to Moscow. This trip was across a terrain somewhat like the cut-over lands of Northern Wisconsin and Minnesota and occupied mostly by what would be termed backwoods farming communities, with a fair amount of livestock. Moscow is the business as well as the political center of the nation, although the heaviest railway traffic routes do not pass through there, but are confined to the industrial regions farther south. After several days study of the Moscow terminals, we went southerly through the Ukraine and inspected the terminals adjacent to the great coal and iron mining regions about 500 miles from Moscow. The most important of these are the Donetz Basin coal fields, and the Krivoy Rog iron mines which are about 200 miles west of Donetz. Together they constitute the heart of Russia's industrialization plans in Europe. The Donetz coal and the Krivoy Rog iron, as I have said are about 200 miles apart, the former to the east and the latter to the west of the Dnieper River. On the Dnieper, some 100 miles to the south of the coal and iron deposits, is the so-called Super-Power Plant, which was under construction in 1930 and recently has been completed. It was built by Colonel Hugh L. Cooper of Keokuk Dam fame. Electrical power from this plant supplements the coal and iron. These sources of raw materials and water power are roughly half way between Moscow and the Black Sea, and here is the heaviest railway traffic density to be found within the limits of the Union of Soviet Socialistic Republics. Production capacity of coal and iron mines were being enlarged and smelters, rolling mills, and factories were being built at suitable places on the Dnieper River and elsewhere in the triangle formed by the Donetz coal mines, the Krivoy Rog iron field, and the Dnieper Dam. Hectic activity in every kind of construction was evident throughout this region.

In addition to the industrial traffic the Ukraine produces a large volume of agricultural tonnage and is the most densely populated section of rural Russia. The Ukraine was the first great wheat growing area which we saw. The surface of this country is a rather flat rolling prairie, not unlike the territory between Chicago and St. Louis, and until one nears the Black Sea practically the whole country is under cultivation. There are three double track railway routes connecting the Ukraine with Moscow.

We visited the Crimea and spent two days on the Russian Riviera in the vicinity of Yalta, some sixty miles east of Sebastopol. This stretch of Black Sea shore along the southern coast of the Crimean peninsula for a distance of about thirty miles adjacent to Yalta was occupied before the world war by the nobility and the rich people of Russia. Attractive villas and beautifully landscaped grounds lined this entire shore. These now have been taken over for pleasure resorts of the workers and peasants, but more especially for the workers, and when we were there towards the end of June all of the villas were crowded with occupants. Usually two weeks free vacation time is given and either free or greatly reduced passenger rates are made to enable the workers to enjoy the various rest resorts, of which the Crimea is the foremost. The transportation problem from the north to Sebastopol which is the gateway to Crimea is chiefly that of passenger business. The railway is mostly double track and, owing to favorable soil conditions for maintaining track and the country being very flat, the track is in comparatively good condition.

From Crimea we returned to the southern part of the Donetz, then southerly through Rostov at the mouth of the Don River, and thence to the North Caucasus country which constitutes the northern slope of the Caucasus Mountains. You will recall that the Caucasus Mountains are about 700 miles long and extend from the Black Sea on the west to the Caspian Sea on the east; they also form the boundary between Europe and Asia Minor. The railway from the north skirts along the north slope of the Caucasus and reaches the Caspian Sea north of the ancient town of Derbent, thence it follows the shore of the Caspian Sea southerly around the east end of the Caucasus Mountains, turns westerly and extends some 700 miles from Baku on the Caspian to Batum on the Black Sea. Thus is described a giant hairpin encompassing the north and south sides and the east end of the Caucasus Mountains.

The North Caucasus country is the second of the great wheat regions we passed through, and the traffic carried on the railway there in addition to agricultural products consists of a heavy tonnage of oil from the Baku oil fields. On the line from Baku to Batum oil is the chief tonnage and that railway, which is about 700 miles long and largely single track, is loaded to capacity. There are two pipe lines which carry oil from Baku to Batum but they are of relatively small capacity. Batum on the Black Sea is the port where the oil is loaded on tank ships for export.

The Caucasus Mountains are by far the highest in Russia, and until recently it has been considered impracticable to build a railroad across them; hence the detour around their easterly end. We crossed these mountains about their middle, by an ancient road known as the Georgian Military Highway. The distance from the railway at Vladikavkaz on the north of the Caucasus to the railway near Tiflis on the south is 120 miles by this highway, while around the east end of the Caucasus Mountains the distance by rail following the great hairpin bend is about 900 miles.

We investigated the feasibility of building a railway across this loop and found that, by following rather closely the route of the Georgian Military Highway and by electrifying the line, a railway could be built with about the same grade and curve characteristics as are used by most of the railways in crossing our own Rockies, Cascades and Sierra Nevadas. The summit would be about 8,000 feet above sea level and the summit tunnel would be approximately six miles long, occupying Kazbek Pass. On either side of this pass are mountains ranging from 16,000 to as high as 18,000 feet elevation in the case of Mt. Elbruz, and approaching the Pass in both directions the perpetually snow capped peaks afford the most sublime and superb of mountain scenery.

The height of land which separates the drainage of the Black Sea from that of the Caspian Sea and over which the railroad from Baku to Batum passes is a southern spur of the Caucasus Mountains and is only about 50 miles east of the Black Sea so that the railway line eastward from this height of land occupies a valley gently sloping toward the Caspian. This is the valley of the Kura River in which the very picturesque and polyglot city of Tiflis is located, approximately half way between the Black and Caspian Seas. The country between Tiflis and the Black Sea is quite similar in appearance and in climate to that of northern California and the products also are similar, consisting chiefly of melons, cherries, apricots, peaches and grapes. We did not see oranges growing but found Persian oranges and tangerines on the Batum and Tiflis markets. Tea is grown along the Black Sea coast. Baku, being the center of the great oil producing region, is a typical, bustling city of the mushroom type, having grown from a small place to a city of half a million inhabitants in only a few years. We went on a small steamship from there across the Caspian Sea to Krasnovodsk, about an eighteen hour trip, and there began a four-day journey through the hot desert sands of Turkestan. This single track railway line of about 1,200 miles from the Caspian Sea to Tashkent was built in the '80s as a military road along the southern boundary of Russia. It traverses a generally flat country with sand as white and fine as drifting snow of the northern winters. To the south the mountains which form the boundary between Russia and Persia are often visible. The temperature reached 120 degrees Fahrenheit every day in the desert. This railway, which formerly served as a military measure, now carries a fairly large volume of traffic due to the fact that at its eastern end in the vicinity of Bokhara, Samarkand, and Tashkent vast tracts of land are being irrigated, and also due to the completion of the railway which connects Turkestan with Siberia to the northeast of Tashkent, thus giving a through route for lumber, cotton, and grain to flow southward and west-

ard and for oil to flow eastward
d northward from the Caspian. The
e is single track and of light con-
ruction. Strange phenomena in
ossing these desert stretches, espe-
ally as one nears the eastern end,
e four or five wide rivers of clear
ater flowing northward out of the
ountains to sink in the sands to-
ard the Aral Sea. These magnifi-
nt streams, whose flow is quite de-
ndable because of their sources in
e snows of the northwestern spurs
the Himalayas, provide the water
r irrigating the large projects
ich are partially completed and
ll supply the larger ones which are
anned for the future. One of these
vers, the Oxus of Alexander's time,
as in flood when we crossed it early
July and a full mile and a quarter
de.

At Tashkent we met Arthur Pow-
Davis, who had been there for
ore than a year in charge of lay-
g out the irrigation projects, which
ere being developed. He told us
the vastness of the possibilities,
essing the favorable soil and cli-
ate, as well as the abundant supply
water. You will remember that
r. Davis was for some years head
the United States Reclamation
rvice and first conceived the Boul-
r Dam project which is now being
rried to completion, and for which
was consulting engineer at the
ne of his death a few months ago.

One cannot visit these old cities of
hkara, Samarkand and Tashkent
thout being greatly impressed by
e evidences of ancient grandeur
d pondering the changes which
ne has wrought. This is the coun-
y of Ghengis Khan and Tamerlane
d the latter made Samarkand the
ost magnificent capital of its age.
e history of its once dominant po-
ion seems utterly fantastic and
real in view of its present remoteness and inaccessibility from the important centers of commerce and culture. We think of Tamerlane and Ghengis Khan as symbols of faded glory, but Samarkand was an ancient city and the river valleys there were old in history before Tamerlane. Alexander the Great campaigned through them before the Christian Era and who can tell how long civilization had known them already.

The westward flow of progress has left these valleys with their relics of early magnificence and power in a quiet eddy for centuries. Even now their relative activity is merely local and they seem destined to remain far from the main current of events and the ruins of their gems of architecture crowded by concrete factories and square squat socialistic apartment houses.

Soon after leaving Tashkent we reached the newly created Turkestan-Siberian line, commonly called the Turk-Sib. This line is proudly pointed out as the greatest single accomplishment of the Soviet Government. It is about 900 miles long and like the line from the Caspian Sea to Taskhent follows closely the international boundary between Russia and Mongolia. It was planned by the Czar, and about 300 miles of line were built from the Trans-Siberian Railway at Novo-Sibirsk southerly to Semipalatinsk on the Irtysh River. The new railway between Tashkent and Semipalatinsk is through the Kirghiz Steppes which extend westward from the foothills of the high range of mountains forming the Mongolian frontier. It is a semi-arid country occupied by tribes of nomads —the Kirghiz—who live in circular houses called Yurtas, which resemble Indian tepees, set on vertical circular walls three or four feet high. These nomadic people live almost entirely on the bands of sheep which they follow northward in summer and southward in winter. The Turk-Sib is single track with one per cent grades and construction similar to a secondary or branch line in this country. The traffic will consist almost wholly of through business, chiefly products of forests and grain from the north, and oil, cotton, and products of irrigated lands from the south.

At Semipalatinsk and from there northerly 300 miles to a connection with the Trans-Siberian railroad at Novo-Sibirsk, we were in the third wheat region visited and the largest in Russia. A short distance to the east is the great Kuznetz coal field, and 1,200 miles westerly from the Kuznetz coal is abundant iron in the Ural Mountains. The Kuznetz coal, together with coal, iron, and other mineral deposits in the Urals, constitutes the basis for the second major industrial activity of Russia which is located in and easterly from the Ural Mountains—in other words, between the Kuznetz coal fields and Urals which are 1,200 miles apart. The Siberian plains which lie between the Kuznetz mines and the Ural Mountains are almost as level as a floor, so that although the distance which coal and iron have to be transported is long, the traffic can move over practically level grades and the transportation cost will be relatively small. Here, as in the Ukraine mining, refining, manufacturing and city building, all are being planned and developed simultaneously at several strategic places. The immediate output of factories is to be harvesting and other agricultural machinery to take care of the needs of this great Inland Empire which is more than 2,000 miles from a seaport.

We returned from Novo-Sibirsk by a line which crosses the Ural Mountains near Chelyabinsk which is the site of one of the large tractor factories. The Urals are negotiated on one per cent grades and the railway summit is about 2,600 feet above the sea. This is a fairly good railway but the traffic is too heavy for it and is increasing rapidly. To provide for present and future business the line is being double tracked. West of the Urals we passed through the Volga Valley, which is the fourth large wheat growing region we saw and in normal years a beautiful fertile country. It was hard to believe the stories of famines such as that of 1921. From the Volga at Samara back to Moscow the railway crosses a rolling prairie country, in appearance much like that of northern Missouri. It is a very old settled country and was fought over back and forth by the Tartars and the Russians as early as 700 years ago. The railway from the Volga River at Batricki (60 miles south of Samara) to Moscow is mostly double track and the last 250 miles from Pensa to Moscow is as good as any in Russia.

After a short stay in Moscow we went to Leningrad (formerly St. Petersburg) over the double track line, which in some ways is the best railway in Russia. The distance is about 350 miles and the line is nearly straight and fairly level all the way. The country is rolling and partly wooded and was formerly occupied by many large estates. This line was built by the American engineer, George Washington Whistler, who came as a small child to Chicago when his father, Captain John Whistler, established Fort Dearborn. George Washington Whistler's son was James McNeill Whistler, the famous artist.

It was concerning the line between Moscow and St. Petersburg that the story is told of how the Czar when he learned that the several large land owners were trying to influence the location of the line to pass by their laces, solved the problem by laying straight-edge on the map and expressing the wish that the line be uilt as nearly straight as possible. Leningrad presents the problem of busy ocean port where heavy transfer of freight is made between rail nd ship, although most of the export rom Leningrad is lumber and pulpwood and most of that moves down he Neva River on rafts or barges.

We left Leningrad after four days nd made the trip of about 6,500 niles to Vladivostok with no stopovers except a day or a half day here nd there to inspect terminals. This oute is through a flat and somewhat marshy wooded country most f the distance west of the Urals, nd east of them the great Siberian Railroad traverses first about 1,200 niles of level plains where wheat is he main production, then through more forbidding country on account f the intense cold, where furs, gold nining, and some lumbering constitute the chief production. The first f these regions was partly covered n our trip from Novo-Sibirsk to Omsk, and is the scene of great industrial activity in the industrialization program. Only two or three features were especially interesting rom the railway viewpoint in the econd region, that is east of Irkutsk. The railway line around the outh end of Lake Baikal for a distance of about 150 miles involved onstruction work quite similar to hat encountered in the mountains of he western United States and is the eaviest construction work in Russia. Easterly from Lake Baikal the crossing of the Yabloni Mountains takes he railway over the highest point eached, which is about 3,600 feet bove the sea, although no particular hysical difficulties are encountered. Easterly from Chita we went by the All-Siberian route lying north of the Amur River rather than by the shorter Chinese Eastern through Harbin, and for 1,200 miles east of Chita we traveled over ground that is perpetually frozen to a depth as great as 300 feet. When the surface thaws out in summer and when this surface freezes again in the early fall, there are serious maintenance problems which are not encountered in the United States. The coastal strip, 300 or more miles wide, has much milder climate and lumbering, stock raising and farming are engaged in extensively. Kharborovsk, where the railway crosses the Amur and turns south to Vladivostok, is a city of 100,000 and growing. From Chita to Vladivostok but more particularly from Kharborovsk on, military activities were everywhere evident. It was explained that these preparations did not mean aggression but did mean defense against any attempt to take any part of Russian territory. The Amur River bridge is the longest in Russia, approximately 8,000 feet. Like many others it had been partially destroyed during the civil war of 1919-1920. The Russians were especially indignant about the destruction of spans in this and other bridges in Siberia by the retiring Japanese army and spoke of it frequently.

This sketch I hope, will give you an outline of our itinerary. We had found that the topography of most of the territory in the Soviet Republics is about as flat as the Mississippi Valley and that the country as a whole is singularly devoid of mountain areas, there being only three ranges, the Caucasus, which are very high and rugged but are not now crossed by any railway, the Urals, which resemble the Alleghanies, and whose passes are about 2,600 feet above the sea, and the Yabloni range of Siberia, which the Trans-Siberian

Railroad crosses at about 3,600 feet elevation. The climate for the most part is about like that of our northern states but comprises extremes of both heat and cold somewhat beyond our limits. The railway duty as regards commodities, is much like that of this country, the heaviest traffic being in coal, lumber, grain, livestock, and iron. The average length of haul of freight was about 50% longer than that in this country.

Now the basic feature of improvement in our railroad transportation plant has been the development of larger and larger units both in cars and locomotives, and consequently the handling of more and more tons per train. In other words, the idea of mass production has guided the railway managements as it has manufacturers in America. This has resulted in reducing the grades on important traffic routes to as nearly level as practicable, sometimes at tremendous expense. No such policy has been followed in Russia. They have not made any special effort to reduce their gradients and they have fairly steep grades even in flat country. Their cars are about 24 feet long, with a single pair of wheels at each end and have a capacity of about 12 tons, which compares with 46 foot cars having about 47 tons average capacity here. Their locomotives are correspondingly light and their trains carry about one-fourth as much freight as ours. Their freight cars are not equipped with air brakes and only about one car in six has even hand brakes. They do not have automatic couplers, but use the hook and link with a turnbuckle to take up the slack after the hook has been inserted—a slow process and also a very dangerous one.

Track construction is naturally light in accordance with the requirements for the lighter equipment and locomotives; the heaviest rail weighs about 90 pounds to the yard and the average rail on the main lines is about 70 pounds to the yard; ties are small, with wide spacing; ballast, where used, is taken from wayside pits without any preparation and for the most part consists of sand. In only one respect is the track of the Russian railways equal to that of the United States, and that is in the matter of gauge, theirs being five feet, instead of 4′8½″ which is our standard. The five ft. gauge, in my opinion, is equal, if not superior, to 4′8½″, and is particularly adaptable for the American railway ideal of mass transportation in large units.

There were practically no improved highways in Russia and very few automobiles, practically all of those being assigned to Government officials, or being used as taxicabs in the larger cities. As a result of this, and also as a result of the policy of granting two weeks free vacation, with either free transportation or exceedingly low rates, passenger trains were greatly over-crowded. It was common to see them with 15 or 16 cars all loaded to capacity, and usually several times as many people would be waiting at stations for the trains as could be accommodated, so that around all the railway stations there were always large throngs of people, some of whom evidently had been waiting for considerable periods. The passenger train accommodations would be considered very crude in this country, only a small portion of the cars being of the so-called soft seat variety, and in a good many instances, on account of the railways being taxed beyond their capacities, people were being handled in box cars. A larger percentage of the total railway mileage is double track than in America. Doubtless this was due to the policy of going from single

ack to double track operation
ther than undertaking to develop
geater capacity on single track
ilways as we have done by the use
signals and a system of train dis-
tching unknown to Russian rail-
ay practice.

Perhaps the most significant sta-
tics reflecting the relationship of
e railways to every day life in Rus-
compared with this country are
e following: The country is about
o and one-half times as large as
e United States. It has perhaps
e-third more people, but only one-
th as many miles of railway. The
eight traffic density per mile of
ilway in 1930 was quite similar to
e freight traffic density per mile of
ad in the United States. The pas-
nger traffic density was probably
ur or five times as great. This
uld indicate that people move
out one-sixth or one-seventh as
any tons of freight per capita as
do on the railways, and travel
most as much per capita as we do.
is of course does not by any means
present the relative amount of
avel done in the two countries, be-
use the railways in the United
ates handle only about one-tenth
the total traveling of the Ameri-
n people, the other nine-tenths be-
done on the highways, and the
eight figures do not include the
ount of trucking done in America,
ich is quite considerable. The
ount of traffic moved per employe
the Russian railways is not quite
e-third as much as is moved per
ploye by our railways. I should
t be surprised if this corresponds
irly closely with the production in
her lines as well as in railroading.
e production of their coal mines
ns about a ton per employe per
y, although that may have been
ised considerably in very recent
ars because of mechanization. I
believe the average production per employe in the United States is about 5 tons. The total coal production in all Russia is about 60,000,000 tons per year, compared with about 500,000,000 tons in this country, or about one-tenth as much coal per capita as we produce. Incidentally Russia's total production is about equal to the normal output of the State of Illinois.

It was our opinion that there are no physical reasons why the American standards, methods, and practices of railroading would not be well adapted to the needs of Soviet Russia in accordance with their industrialization program. When we were there this program had been under way for about two and one-half years, although rehabilitation of the country had been gradually going on for five years. This industrial movement predominated and permeated the entire life of the country. There was construction of every kind, including the planning and building of entire cities with all of the types of construction involved in such undertakings. We saw the building of immense factories, the opening of mines, the building of railways, the building of water works, sewer systems and streets and the rebuilding of these for the large cities like Kharkov and Moscow, whose population has increased so rapidly as to completely outgrow the old facilities. This attempt suddenly to change from an almost wholly agricultural country to one of industrial importance of course brought about the most far reaching and violent changes in the lives of the people, and everywhere there was migration from the peasant farms and villages to the construction jobs and factories. This migration was noticeably that of the younger and more vigorous and enthusiastic persons and for that reason as well as the fact that it is all being carried on to the accompaniment of extensive propaganda, there was evident a great amount of enthusiasm among the workers. Practically all of the theatrical programs which we saw included communistic allusions, all newspapers are strictly censored, parades are arranged for frequent celebrations and in every conceivable way the success of the party is acclaimed. In the larger cities where one would come in contact with a cross-section of the entire population the physical and mental strain of the drive was very apparent. Except at the vacation resorts and in some remote regions the people do not laugh and indulge in gaiety. Everywhere they were exceedingly shabby, and none too well fed. The women have taken as important a part in the work as the men and do their full share of the hard physical tasks; fully one-half of the track forces on the railroads are women. They do not have any time or opportunity or facilities for keeping themselves well dressed or well groomed, and this is true of all the women, all of whom, except for short periods allowed for child bearing, are expected to work. Members of the theatrical profession by the nature of their calling of course do present a different appearance and are very noticeable when seen in public.

The period of planning and construction had not yet passed when we were there and of course the success of industry will depend on the ability to operate plans as well as to plan and build them; in fact, the planning and building there was largely carried out under direction of foreign engineers and contractors. There is no doubt whatever but what improvements of the character I have indicated were being successfully built in a most extensive way.

The thought behind the entire movement of course is to raise the standard of living by making use of the natural resources of the country and converting these natural resources into modern living conveniences which are enjoyed by the highly industrialized countries of the world. In order to finance this vast undertaking in the absence of long time credit, there was no choice but to pay for the material, tools, and machinery brought in from other countries, and there was only one way in which that could be done, namely, by exporting raw products and selling them in the world markets so as to be able to buy what was needed. This is perhaps the most vital point about Russia's so-called Five Year Plan as it affects the United States and other foreign countries. A country consisting of 160,000,000 people, most of whom have never known anything but the lowest standards of living, is foregoing many of the necessities of life in order to finance improvement work through which it hopes ultimately to raise its people's standard of living. They are without adequate clothing, many of them are without shoes; they are under-nourished and being fed according to a system of rationing more rigid than ever has been known outside of famine or war times, and yet in this situation they are being obliged by the program which has been adopted to export from their country the very things they need so badly. It is a surprising fact of great importance which is not in any way suppressed or denied in Russia that except for such things as manganese ore, caviar, furs, and a few other things, they do not have any exportable surplus except as it is artificially created through the greatest of deprivation and sacrifice. Al-

ıough showing plainly the hardships
ırough which they had passed and
ere passing, there was an astonish-
g enthusiasm about what they were
ccomplishing and through the all
ervading propaganda by the press,
y word of mouth, and by radio each
ccomplishment in the way of prog-
ess or completion of a building or
b was well advertised and used for
e best effect on the morale. A
aracteristic of the people from one
d of the country to the other was
eir great eagerness to learn. There
as naturally some curiosity concern-
g a group of American railway men,
t their main purpose in gathering
ound at every opportunity as we
sited the shops, roundhouses and
rminals was to hear, and if possible,
take part in the series of questions
d answers that were being ex-
anged. Illiteracy is disappearing
ite rapidly—night schools are ev-
ywhere prevalent for the adults and
e stress which is being placed upon
ild education and care is well
own.

The question most often raised in
nnection with Russia is the menace
Communism, should any closer
ntact be maintained. Our obser-
tions led us to think that the surest
re for Communism in this country
ould be for our people to know ex-
tly how the people in Communistic
ussia live and do not prosper. The
xt question seems to be whether,
Russia prospers, she may not inter-
re with our own success. It is dif-
cult for me to see how we could
nefit by keeping that great nation
any lower level of existence than
ey might attain, even if we could
so. They need their lumber, coal, oil and food at home and will use them for generations if they can avoid sending them abroad. On the other hand, the idea that we can prevent Russia from making advancements in science and industry is almost as fantastic as it is egotistical. Germany and other countries are courting the opportunity to give technical advice and provide the machinery and equipment for Russian development.

Our short visit convinced us that our people have nothing to fear from Russian competition and also that her communistic planning is not for us. This is not to say that in the long evolution, of which her present experience is a phase, it was not necessary for Russia to pass through this stage. As to that I do not pretend to know. But our people are so different in background and temperament, our situation so diametrically opposite as respects supply and demand, and our standards of living so far above theirs that I am satisfied whatever route we may travel in our search for a way out of the maze created by our unbalanced distribution, their way, that is the Communistic way does not offer us any promise.

At the conclusion of his talk on Russia, Mr. Budd was given a rising vote of thanks for his splendid address and the wonderful information he gave on modern conditions in Russia.

President Hamilton then turned the meeting over to the incoming President, H. A. Treadwell, who, after making a few appropriate remarks, declared the meeting adjourned sine die.

THE ILLINOIS COAL INDUSTRY

By JOHN E. JONES
Safety Engineer, Old Ben Coal Corporation
West Frankfort, Ill.

The following article is an address delivered some months ago to many civic clubs and printed in the daily press of many of our cities in Illinois. It is an economic view of the state's coal industry from the earliest records up to the present time. The picture presented indicates the trends of the state's coal mining industry, the present trend being definitely downward. It is an article well worth the study of any who depend upon the coal industry for a livelihood, and is worth preserving for future comparison and reference.

Any address upon industrial development is bound to contain tabulative data and statistics. Such are invariably difficult to follow, so I have chosen to give the tabulations graphically, hoping by this method that I can give you a mental picture of the coal industrial condition in general and that of Southern Illinois in particular.

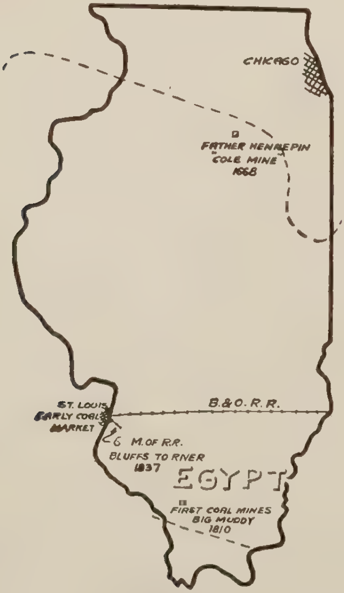


CHART NO. 1

Early History

Chart No. 1 is an outline map of Illinois. I have shown here the leading early historical events relative to coal.

The first reference of coal transportation in the Middle West is eight years before Illinois became a state. In the second biennial report of the Bureau of Labor Statistics of Illinois it states that coal was mined in Jackson County as early as 1810 and was conveyed by flat boats down the Big Muddy to the Mississippi river. Occasionally the coal was taken as far as New Orleans. This was six years before Jackson county had become a county. No other record of mining appears until 1832 when several boatloads were sent from the same vicinity to market. The next year 6,000 tons are recorded to have been hauled in wagons from the bluffs in St. Clair county to the St. Louis market.

In the year 1835 a company was organized under a special charter from the State Legislature for the purpose of mining and shipping coal in Jackson county.

The year 1833 marks the beginning of government records of the production of coal in Illinois. A gradual increase is shown per year until in 1881, 6,720,000 tons were produced, or a total from beginning of operations to and including 1881, of about 74,000,000 tons.

Outcrops of coal occur in many parts of the state. Father Hennepin

1668 recorded the location of a le mine" in the Illinois river bluffs. is natural, however, for the develnents to begin here for it is in ypt that recorded population began.

Early Markets

The chief requirements for coal re for river navigation and for the ger settlements. Many of our pres- larger cities had begun and by 9, when the seat of state governnt was moved to Springfield, coal ustrial possibilities were fairly l recognized. From Perrin's hisy of Illinois we get "The impulse ard improvement was not alone in public mind, but private enterses also began to be set on foot. us was formed by ex-Governor ynolds the project of a plan on prie account to build a railroad which y justly lay claim to having been first in the Mississippi Valley and fact the entire West. This was in 7. It ran from the Mississippi er, from the site of the present city East St. Louis, eastward across American Bottom for about six es to the Bluffs. These Bluffs are ange of hills full of coal and it s in order to connect these coal ds with the market that this pior western road was built. St. uis on the west side of the Ameri Bottom and across the river was market to be reached." This, the t railroad in our state, six miles in gth, of wooden rails, and horses for tive power, was the pioneer raild in the development "of the great l fields of Southern Illinois."

St. Clair county also holds the disction of the oldest mine in the state ords, this being the International l Company mine opened in 1851.

An impetus was given to Southern nois coal mining when the Illinois ntral in 1854 was built. In the ne year L. Ashley and Brothers k a slope mine at St. Johns, two miles north of DuQuoin. This is recognized as being the first railroad shipping mine in the state.

During the Civil War period, the production per year increased at a rate of nearly a quarter million tons per year. By this time railroad building was advancing at an accelerated rate. It increased from 6 miles in 1837, to 3,156 in 1863. By 1881, 8,260 miles of railroad were completed.

From the first coal report we learn: "In 1868 the superior quality of the lower portion of the seam in Jackson county attracted the attention of iron manufacturers, and led to the erection of blast furnaces at Grand Tower for the reduction of Missouri ores, by the use of this coal, which was found sufficiently free from sulphuret of iron to admit of its being used in smelting furnaces in its raw state."

Many mines by this time in various localities in Egypt were in operation, nearly all of them being in coal seams close to the surface. In 1869 and 1881, two other shipping mines were in St. Clair county. In 1872 the first shaft mine at Centralia was completed. By 1882, 192 coke ovens with a total capacity of 1,172 tons daily, were installed in the Big Muddy field. In the same year a Gallatin county mine was opened and later coke ovens installed. The Chicago market caused developments of coal mines in Northern Illinois, especially LaSalle county, so that by 1882 St. Clair county took second place in the annual coal production of the state.

Production History by Graphs

Such is, briefly, the early history of coal mining in Illinois, and especially that of Egypt. In 1882 state annual reports were begun. These reports were, in part, the result of legislation started in 1870. We have, therefore, complete statistics and records of coal mining events for a period of over fifty years.

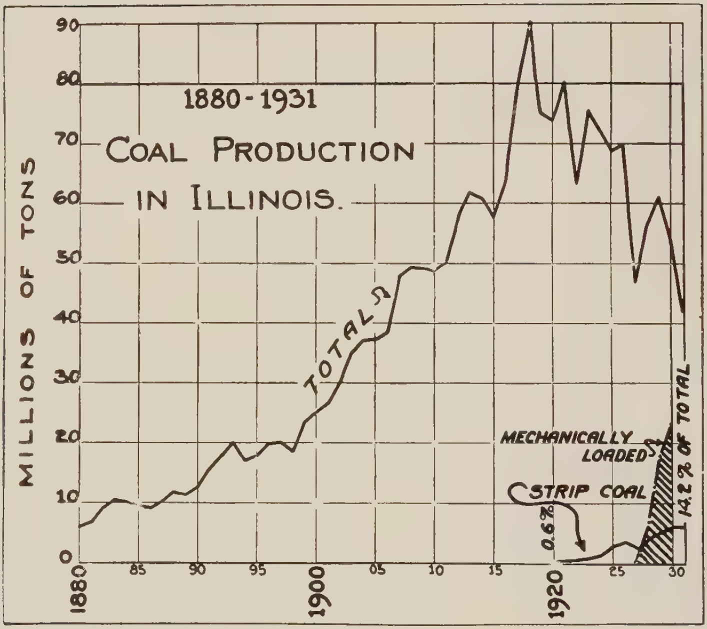


CHART NO. 2

Chart No. 2 is a graph showing the production of coal in Illinois by years from 1880 until January 1, 1932. For 1880 the tonnage was 6,720,000 tons. Production increased year after year until it reached its peak in 1915—89,979,469 tons. Since then production has, in general, declined until last year it was only 43,000,000 tons; the lowest annual tonnage for 26 years.

Chart No. 3 is given to show Egypt's production exclusively from 1918 to and including 1931. I have carefully considered all of the production in the 17 counties that produced coal in Egypt during all or any part of that 19 year period. These counties are named on the Chart. You will note that for our region the peak was reached in 1918, during which year 46,000,000 tons, over half of the peak production of the state, were produced here. Franklin county acquired first place in the state's production in 1915 and has maintained it ever since. This is shown in Chart No. 4. It has dropped 39 per cent from its peak production. The graph for St. Clair county is shown on Chart No. 5. It has dropped 69 per cent from its peak production. Thus is shown charts for the youngest and oldest coal producing counties in the state. As with the state, Egypt's production declined from 1918 to less than half of its peak production—22,000,000 tons in 1931.

There is a set of causes, of course, for the remarkably rapid-coal industrial development of Egypt—and its downfall. My purpose here is to show, in a very general manner, these causes as I understand them. If I am successful, you will have a fair mental picture of the facts concerning the coal industrial development of Egypt when I am through.

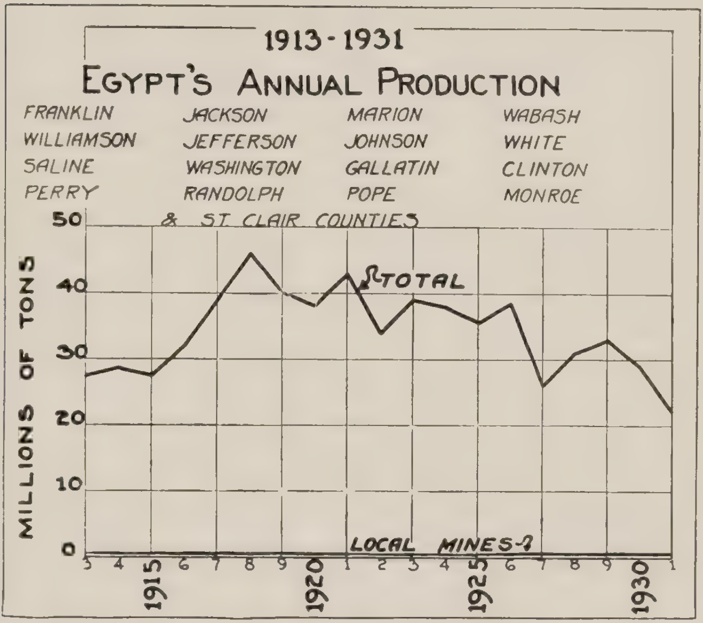


CHART NO. 3.

Chart No. 6 is a map showing the coal fields of the United States. These fields are shown by the shaded area. They include all ranks of coal from lignite to anthracite. You probably know that this does not indicate that coal is everywhere found within a shaded area. It simply means that the formation is that of a coal bearing period in geological structure. One must understand that the importance of a coal area is not necessarily in proportion to its extent. The shaded areas include various thicknesses of coal seams. The Western Interior area, the largest indicated on the map and just west of the Mississippi River, while apparently of vast expanse, supplies only three per cent of the nation's coal production. I have, therefore, shown on Chart No. 7 those coal producing centers which in 1929 gave five million tons or more. These centers also indicate the higher quality coals.

Analyzing this map, one can readily appreciate the natural markets of the various coal producing states. The development of the Pennsylvania coal industry grew with the eastern industries and seaboard cities. Likewise the Western Pennsylvania and Ohio coal industry grew with the steel industry and the Great Lakes trade. It was natural for the Illinois and Indiana coal fields to develop along with the rapidly growing industrial centers, St. Louis and Chicago, and the increasing population in the northwest.

From 1880 to 1930 the population of the United States has doubled. The forepart of this period was a time great in railroad building. This 50 year period has never been equalled in industrial development. Power re-

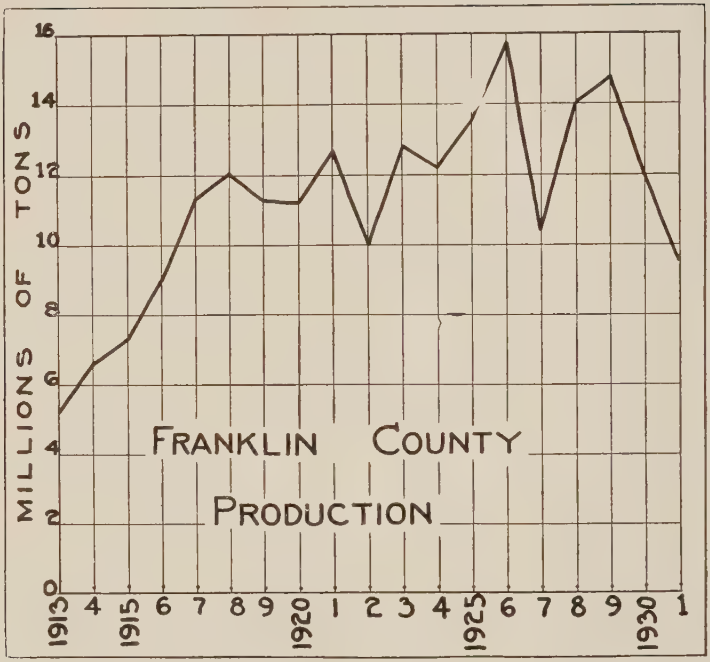


CHART NO. 4

quirements have increased beyond the most radical prophecies. In Chart No. 8, made from Bureau of Mines statistics, is shown the rapid increase in the production of coal (indicated in trillions of B.T.U.'s). From 1879 to 1918, a period of forty years, the increase is nearly nine-fold. In the same period of time Illinois' tonnage increased 18-fold. This doubled increase was due largely to the proximity of the Illinois coal fields to their natural markets and in no little measure to the development and growth of the rich coal field in Egypt. The Nation's and the State's coal production developments have been the natural results of the great industrial development and the population increase while coal was king.

There is a different story to tell for what has happened since the 1918 peak, apparently the turning point in coal production. From that time to and including 1931, the loss of coal tonnage in the Nation is 33 per cent as compared with its 1918 tonnage. But, Illinois and Egypt have both lost 53 per cent as compared with their 1918 tonnages. Granting that it is logical we should decrease in Egypt's tonnage in equal ratio to the Nation's decrease, our tonnage this year would have been 31,000,000 instead of 22,000,000. We, therefore, have lost 9,000,000 tons and in Illinois 18,000,000 tons over and above the proportionate loss of the Nation.

First, I will endeavor to show the cause of the Nation's loss of its 33 per cent. These causes should apply in like proportion to Illinois and to Egypt. On Chart No. 8 I have shown, from the Bureau of Mines figures, the

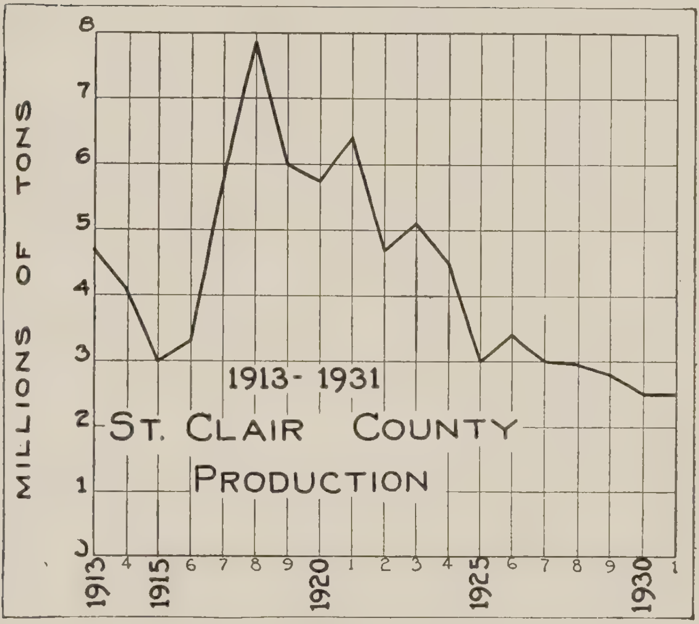


CHART NO. 5

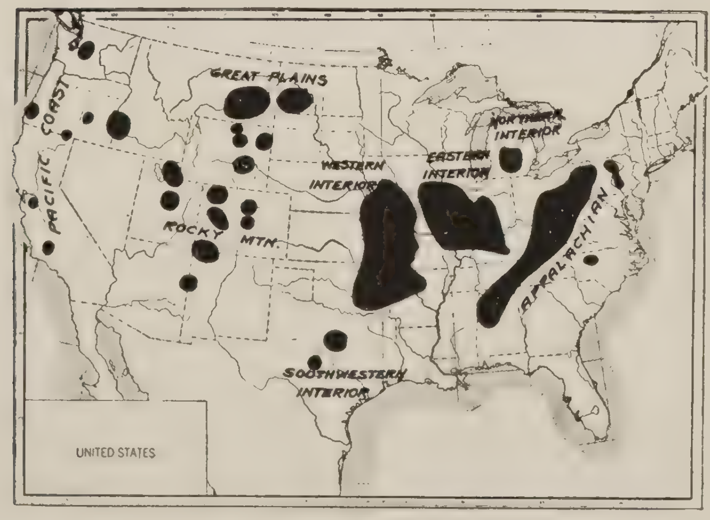


CHART NO. 6

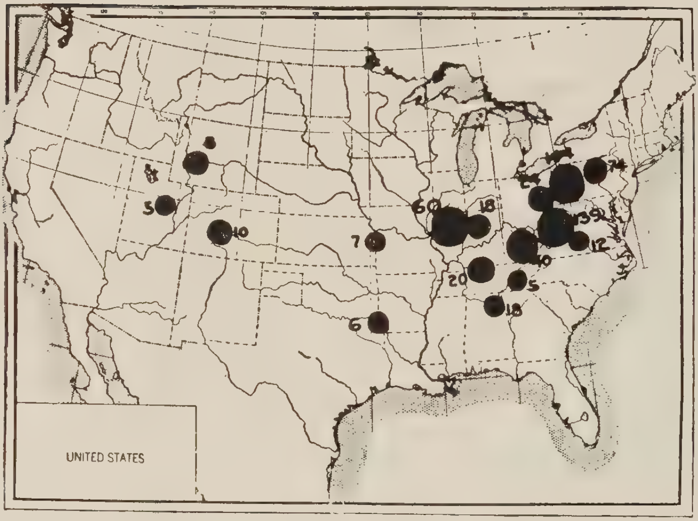


CHART NO. 7

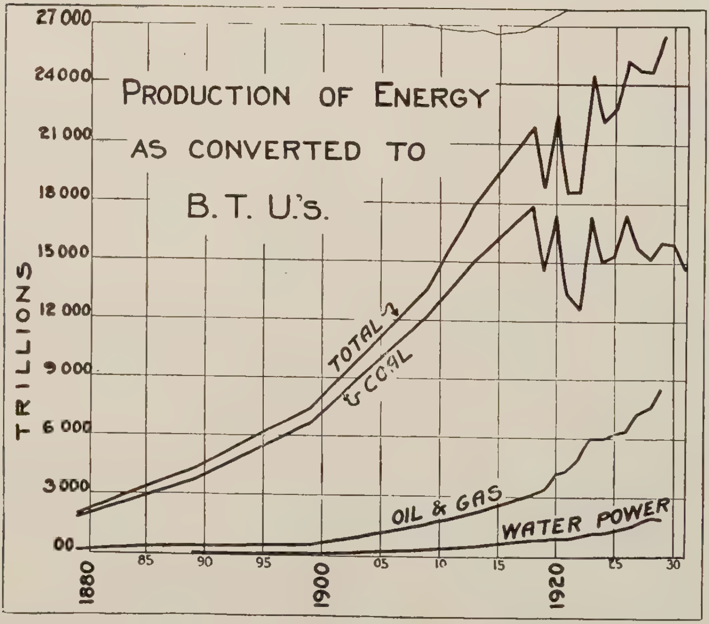


CHART NO. 8

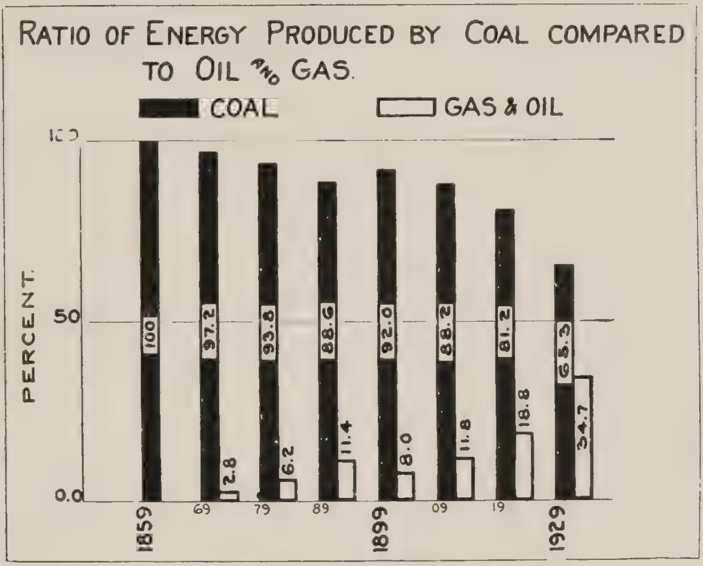


CHART NO. 9

nergy in trillions of B.T.U.'s. When sing different sources of energy, we ust get a common denominator. As reviously stated, coal was king in nergy production for a great many ears. It is still the chief source of nergy, but developments, most espeially in the last decade, have shorn im of his prestige. The other graphs f Chart No. 8 show the development f other fuels on the same common enominator basis. Water power has een of such slight effect as to be conidered negligible here; yet it is now esponsible for 8 per cent of the total nergy produced. Oil and gas, as hown in the ascending graph, are actors of immense importance.

Chart No. 9 shows the inroads of il and gas as energy producers. eading from the graph: In 1899 coal roduced 92 per cent of the energy onsumed that year and oil and gas roduced 8 per cent. In 1929 coal roduced 65.3 per cent of the energy onsumed that year and oil and gas 34.7 per cent. The same story is told more in detail by Chart No. 8. Here the changes are shown annually since 1880 for the three chief energy sources—coal, oil and gas, and water power. Here also, in the upper graph, is shown that the trend of total energy requirements for the Nation is upwards. Since 1929 there have been stupendous increases in pipe lines from gas fields over thousands of miles to industrial centers.

This United States map, Chart No. 10 (Coal Age, Vol. 37, No. 2), shows the 5,000 miles of gas lines laid during 1931. You will note that the majority of this gas line mileage adversely affects our Illinois coal markets. Pipe lines installed previously, now under construction, or proposed, are not shown since their number would be confusing. The possible replacement of coal by just one of the large gas lines across our state into Chicago is many million tons annually. We wonder at this sudden and enor-

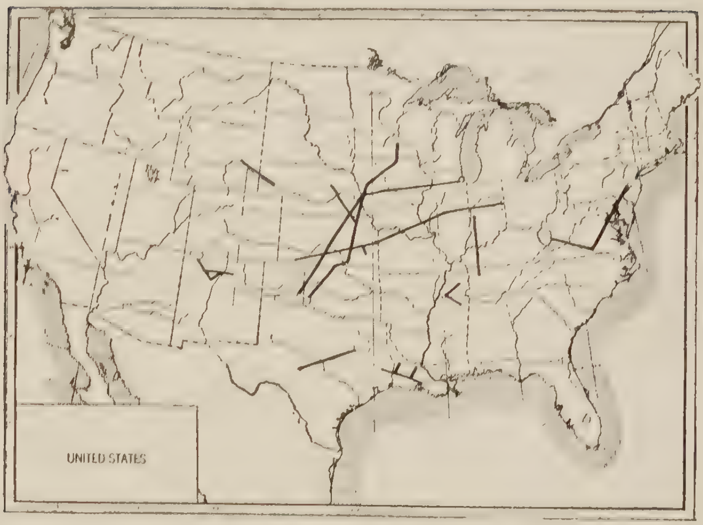


CHART NO 10

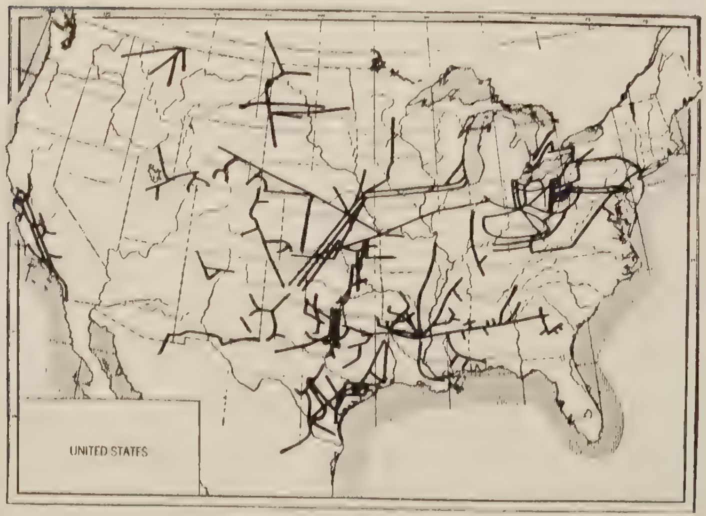


CHART NO. 11

mous increase in natural gas enroachment as an energy producer. As coal men we are concerned that atural gas is increasing at rates, reently, 25 per cent greater than each receding year. The causes are hese. First, pipes of large size and uperior strength manufactured in ass production, and so welded on the ob as to make one long single pipe, ogether with cheap and efficient methods of installation; and, second, successful research into efficient long distance and cheap methods of pumping. Chart No. 11 shows, in the United States, the total gas lines now installed, proposed and in process of installation to be completed this year. This map conveys to you to what great extent natural gas alone has become a competitor of Egypt's coal industry.

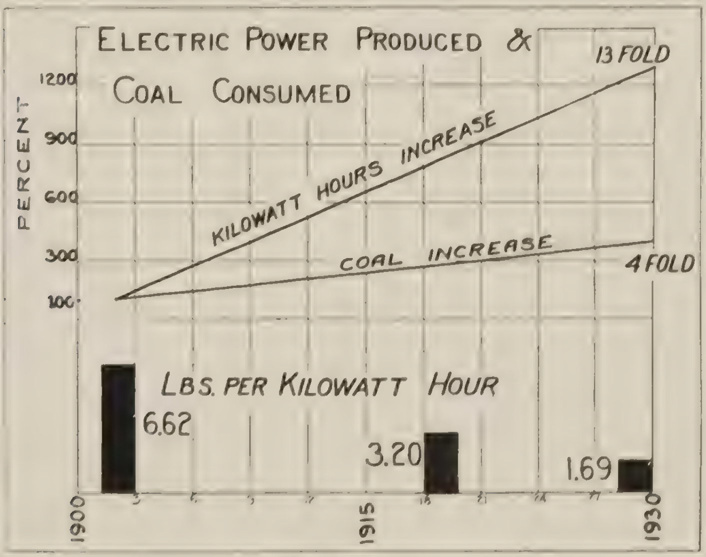


CHART NO. 12

Another cause attributed to the 23 er cent loss for the Nation is the inrease in the efficient use of coal. In he production of electric power it reuired, in 1902 (see Chart No. 12), .62 pounds of coal to produce one ilowatt hour. In 1919 it required .20 pounds, and in 1929 it required 1.69 pounds—a decrease of 47 per ent in coal requirements in the generation of electricity in the last ten year period.

Great increases in the efficient use f coal have been made in railroad transportation. Railroad locomotives consume about 25 per cent of the Nation's coal output. The efficiencies in coal used here, according to the Bureau of Mines, have been such that 75 tons of coal in 1927 would do the work of 100 tons in 1920; thus in that seven year period there was a 25 per cent improvement in the efficient use of railroad fuel.

Likewise there have been efficiencies in the general manufacturing industries, 22 per cent; the steel industry, 11 per cent, and the domestic

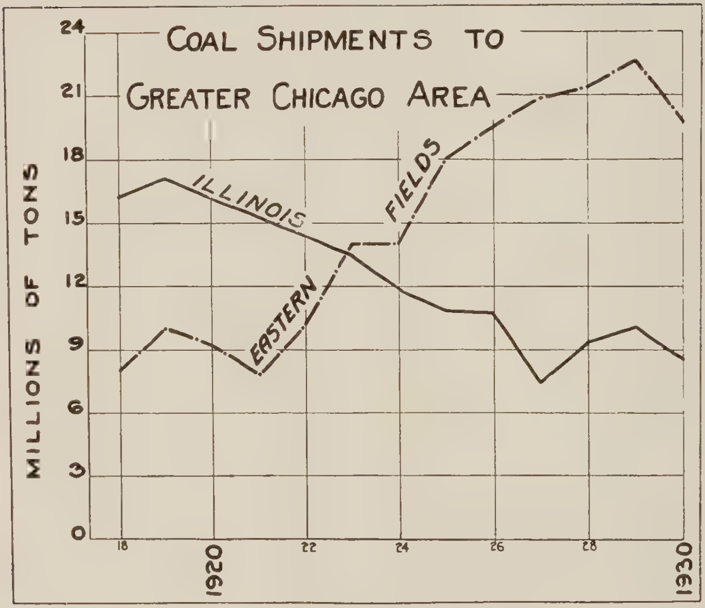


CHART NO. 13

market. The amount of saving in the domestic consumption of coal per unit of energy produced is rather indeterminable, yet with increased knowledge upon the correct firing of coal, improvement in heating equipment, and the more recent advent of mechanical stokers, there is bound to be a telling improvement in such use of coal.

As stated, however, Illinois and Egypt have suffered an additional 20 per cent loss from the peak of 1918 to the close of 1931. Where much of this tonnage has gone is graphically illustrated on Chart No. 13. Here the shipments to the Greater Chicago area from 1918 to 1931 are shown for Illinois and for Illinois' chief competitors, the Eastern districts. These Eastern districts are the West Virginia and Eastern Kentucky coal fields. As shown, Illinois' tonnage has decreased over this twelve year period from over 116,000,000 to 8,000,000, while the Eastern districts have increased from 8,000,000 to 22,500,000.

Not only have we in Egypt taken a defeat along with the rest of the Nation in our inability to compete with other energy producers than coal, accepted our share of tonnage loss because of the higher efficient use of coal, and shouldered our proportionate share of loss due to the depression, and its consequent decrease in the use of coal, but we have also lost in our own natural markets in competition with producers of coal who are much farther from our markets than are we. In other words, we have not even held our own relative position but have sunk farther than the general depression of the coal industry has sunk.

Chart No. 14 shows graphs of Kentucky's, West Virginia's and Illinois' percentage of change in production from 1917 to and including 1931. The

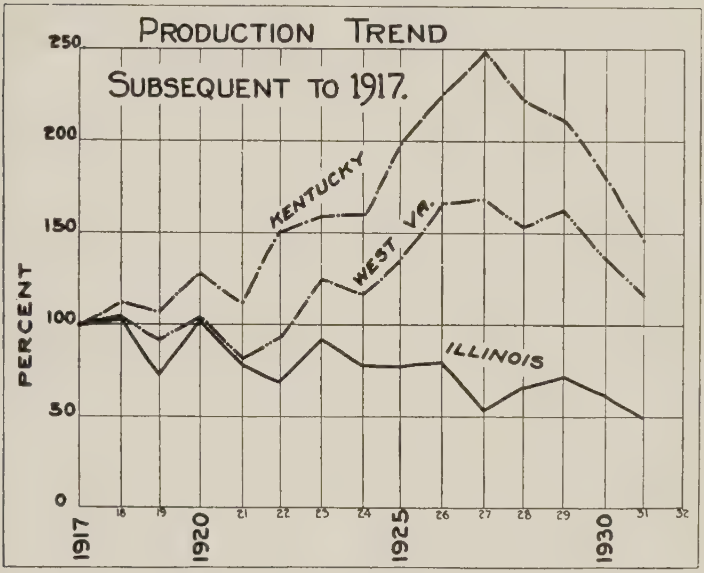


CHART NO. 14

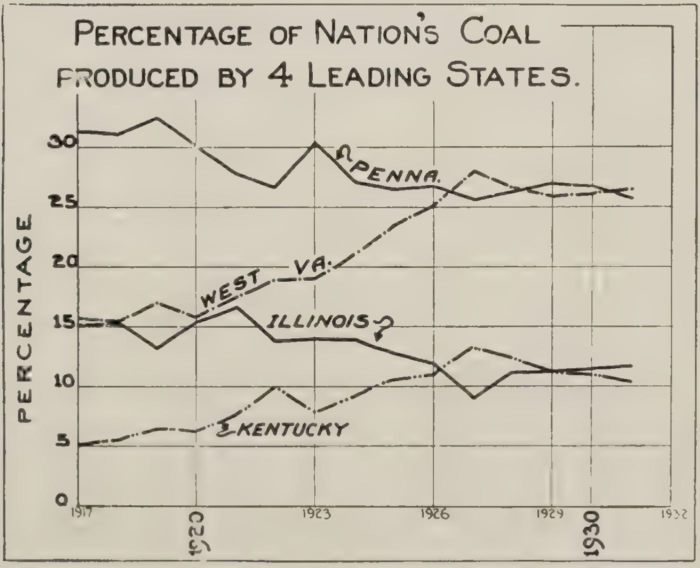


CHART NO. 15

chart needs no explanation, simply graphically showing that our chief competitors in coal production have gained each year above the 1917 production and Illinois has lost each year.

Chart No. 15 is given to show from 1917 to and including 1931, the percentages of production of the four chief coal producing states, Pennsylvania, West Virginia, Kentucky and Illinois, compared with the Nation's production of 100 per cent each year. Pennsylvania, since 1917, has dropped from 31.2 per cent to 25.7 per cent, West Virginia has increased from 15.7 per cent to 26.4 per cent, Kentucky has increased from 5.1 per cent to 10.5 per cent, and Illinois has dropped from 15.2 per cent to 11.7 per cent.

Looking Ahead

There has been invested in Franklin county not less than fifty millions of dollars in coal mining property, twenty-five millions of dollars in homes, and immense investments in business and public buildings that have resulted almost entirely from the mining industry. This is typical of many communities in the entire state. The value that this represents in Egypt rests upon whether or not the industry can be kept intact, can be made to be self-supporting and, perhaps, again be made to prosper. If the existing facts are faced separately and honestly, the alarming trend indicated by these charts can be turned into a happier condition. The problem is not one of civil strife between the employer and the employee, it is not a question of barter between these two forcés as to the share each shall receive. It is a more momentous problem than that. It concerns whether or not there shall be anything to share. The strongholds of the Illinois coal industry have been invaded by outside competition. The two forces must, if success is to be had, join into one to forge ahead towards the goal of holding our coal industry intact and on to the successful maintenance of the industry which our natural conditions and location warrant.

Rarely if ever does a sound principle fail when the true facts are studied and understood, and when all the forces unite to make that principle successful. This problem is a perplexing one and apparently an insurmountable one. But only apparently is it insurmountable. Courageous, definite and intelligent analysis and action will win for the industry here with its great resources that which rightfully belongs to it. I do not presume to dictate the solution. I do most earnestly urge discarding antagonistic prejudice for concerted action solely based on facts. The only question now weighed in the balances is whether or not this will be done in time.

CONSTITUTION AND BY-LAWS

Adopted June 24, 1913
Amended Nov. 12, 1926
Amended Nov. 8, 1929

ARTICLE I.

NAME AND PURPOSE

he Illinois Mining Institute has
its objects the advancement of the
ing industry, by encouraging and
noting the study and investigation
nining problems, by encouraging
cation in practical and scientific
ing, and by diffusing information
egard to mining that would be of
efit to its members.

ARTICLE II.

MEMBERSHIP

ection 1. Any person directly en-
ed or interested in any branch of
ing, mining supplies, mining appli-
es, or mining machinery may be-
e an active member of the Insti-
. Any person desiring to become
ember of the Institute shall fill
a blank for that purpose, giving
name, residence, age, and occu-
on. This application shall be ac-
panied by one year's dues of
0. Each application for mem-
hip shall be submitted to the Ex-
ive Board, who shall make an in-
igation as to the qualifications
he applicant, and shall be author-
to elect to membership and issue
ertificate of membership to such
licant subject to the ratification
he next regular meeting of the
itute.

ection 2. Any person of distinc-
in mining may be elected an hon-
y member of the Institute by two-
ds vote of the members present at
regular meeting. Any member
has been an active member of
Institute and shall have retired
n active business in mining may
ome an honorary member.

ection 3. The annual dues for ac-
members shall be $3.00 and any
son in arrears on August 1, of the
ent year, after having been sent
two notifications of dues, to be dropped from membership. Members in arrears for dues will not receive the printed proceedings of the Institute.

Section 4. Any active member may become a life member by the payment of $50.00. Funds received from life members are to be invested and only the income from these funds may be used in the regular operation of the institute.

ARTICLE III.

OFFICERS

Section 1. The officers shall consist of a President, Vice-President, Secretary-Treasurer and twelve Executive Board members. The services of all officers shall be without compensation.

Section 2. Nominations for officers and the executive board shall be made by nominating committee of three (3) appointed by the President at least thirty days before the annual November meeting, provided that anyone can be nominated on the floor of the meeting for any office for which an election is being held.

Section 3. The officers and executive board members shall be elected by ballot, annually, at the regular November meeting and shall hold office for the ensuing year.

Section 4. In case of death, resignation, or expulsion of any officer, the executive board may fill the vacancy by appointment until the next regular meeting, when the vacancy shall be filled by regular election. In case of a vacancy in the office of president, the duties shall devolve upon the vice-president.

Section 5. The executive board shall consist of the officers and twelve other board members.

ARTICLE IV.
DUTIES OF OFFICERS

Section 1. The president shall perform the duties commonly performed by the presiding officer and chairman. He shall sign all orders for payment of money by the treasurer, and with the executive board shall exercise a general supervision over the affairs of the Institute between sessions.

Section 2. The vice-president shall preside in the absence of the president and perform all the duties of the president in his absence.

Section 3. The secretary-treasurer shall keep a record of each meeting, shall read and file all resolutions and papers that come before the Institute, countersign all orders for money which have been signed by the president, and shall purchase necessary supplies under the direction of the executive board.

He shall keep a true record of all money received by him and payments made on account of the Institute. He shall pay out no money except on an order signed by the president, and countersigned by himself, and shall retain these orders as vouchers. He shall give bond in such sum as the Institute may provide, the premium on said bond being paid by the Institute.

He shall act as editor-in-chief for the Institute and may furnish the newspapers and other periodicals such accounts of our transactions and discussions as are proper to be published. His own judgment is to prevail in such matters unless objection is lodged at a regular meeting or by the executive board.

The retiring president shall act ex-officio in any capacity for the ensuing year.

Section 4. The president shall appoint an auditing committee annually to audit the accounts of the secretary-treasurer, and said audit shall be submitted to the November meeting of the Institute.

Section 5. The executive board shall perform the duties specifically prescribed by this Constitution, act as program committee for each meeting, determine what is to be published in the proceedings and shall perform such other duties as may be referred to them by a regular or special meeting of the Institute.

ARTICLE V.
MEETINGS

Section 1. Regular meetings shall be held in June and November of each year and on such days and in such places as may be determined by the executive board of the Institute. Notice of all meetings shall be given at least thirty days in advance of such meetings.

Section 2. Meetings of the executive board shall be held on the call of the president, or at the request of three members of the executive board, the president shall call a meeting of the board.

ARTICLE VI
AMENDMENTS

Section 1. This Constitution may be altered or amended at any regularly called meeting by a majority vote of the members present, provided notice in writing has been given at a previous semi-annual meeting of said proposed change of amendment.

ARTICLE VII.
ORDER OF BUSINESS

At all meetings, the following shall be the order of business:

(1) Reading of minutes
(2) Report of executive board
(3) Report of officers
(4) Report of committees
(5) Election of new members
(6) Unfinished business
(7) New business
(8) Election of officers
(9) Program
(10) Adjournment.

ILLINOIS MINING INSTITUTE

LIFE MEMBERS

OOKS, C. W.....................*Brooks & Stewart, Inc.*, 53 W. Jackson Blvd., Chicago, Ill.
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NCAN, W. M., *Pres*.......................*Duncan Foundry & Machine Works, Inc.*, Alton, Ill.
RCIA, JOHN A.........................*Allen & Garcia Co.*, 332 S. Michigan Ave., Chicago, Ill.
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YCE, A. R...*The Wood Preserving Corp.*, Marietta, Ohio
ACH, B. K., *President*....*Egyptian Tie & Timber Co.*, 514 Rialto Bldg., St. Louis, Mo.
OIZEN, A. S...*Joy Mfg. Co.*, Franklin, Pa.
FADDEN, GEO. C., *Asst. Vice-Pres., Peabody Coal Co.*, 20 N. Wacker Dr. Chicago, Ill.
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NDOE, C. J., *V.-P., West Virginia Coal Co.*, Boatmen's Bank Bldg., St. Louis, Mo.
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HONTHAL, D. C., *President*.......................*West Virginia Rail Co.*, Huntington, W. Va.
YLOR, H. H., Jr.................*Franklin County Coal Co.*, 135 S. La Salle St., Chicago, Ill.
OMAS, T. J., *President*................*Valier Coal Co.*, 547 W. Jackson Blvd., Chicago, Ill.
OMPSON, J. I., *President*....*Koppers-Rheolaveur Co.*, Koppers Bldg., Pittsburgh, Pa.
IR, PAUL, *Vice-President*....................*Bell & Zoller Coal & Mining Co.*, Centralia, Ill.
LLER, HARRY, *Vice-President*...............*West Virginia Rail Co.*, Huntington, W. Va.

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RRAY, HUGH..Equality, Ill.
RRE, FRANK ....7126 Northmoor Drive, St. Louis, Mo.

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RELL, JOHN, *Superintendent*................*Peabody Coal Co., No. 7 Mine*, Kincaid, Ill.
KERMAN, ROBT. *M. M., Cons. Coal Co. of St. Louis*, 612 W. Main St., Staunton, Ill.
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BEALL, C. W. *Beall Bros. Supply Co.,* Alton, Ill.
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BENNER, DALE A., *Alum. Co. of America,* 1825 Boatmen's Bk. Bldg., St. Louis, Mo.
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CALLEN, PROF. A. C. Transportation Bldg., Urbana, Ill.
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LARKSON, JOHN L., *Pres*......*Clarkson Mfg. Co.*, Nashville, Ill.
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AVIS, A. J......*Osborn & Lange*, Insurance Exchange, Chicago, Ill.
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AVIS, WM. H......*Simplex Wire & Cable Co.*, 568 S. Boyd St., Decatur, Ill.
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NCAN, GEO. D......*Duncan Fdry. & Machine Co.*, Alton, Ill.
NCAN, GEO. D., Jr......*Duncan Fdry & Machine Co.*, Alton, Ill.
UNCAN, W. M., *Pres*......*Duncan Fdry. & Machine Co.*, Alton, Ill.
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NN, THOS J......*Old Ben Coal Corp.*, Christopher, Ill.
OE, J. A......La Salle, Ill.
OGAR, R. L......*Watt Car & Wheel Co.*, Barnesville, Ohio

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FENTON, J. R., *V.-P*......*J. K. Dering Coal Co.*, 332 S. Michigan Ave, Chicago, Ill.
FIRMIN, W. H......*Joyce-Watkins Co.*, Metropolis, Ill.
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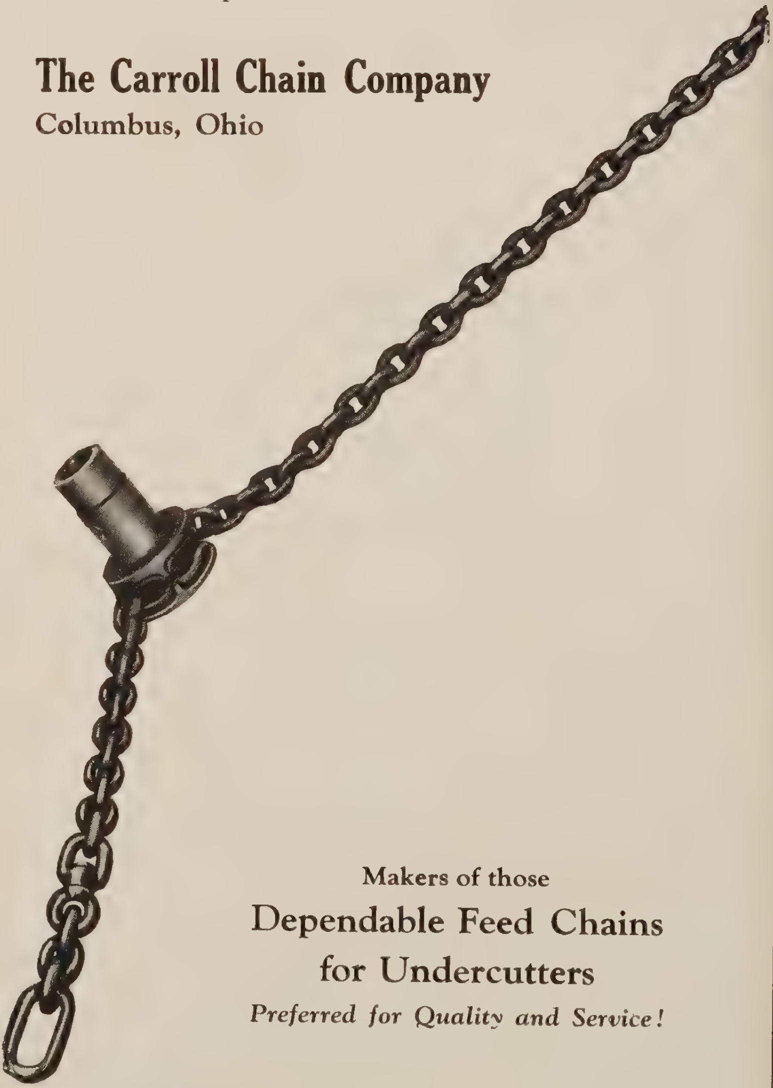

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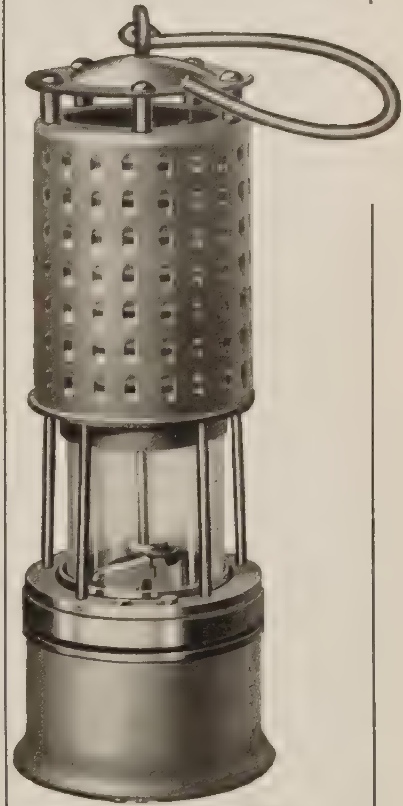

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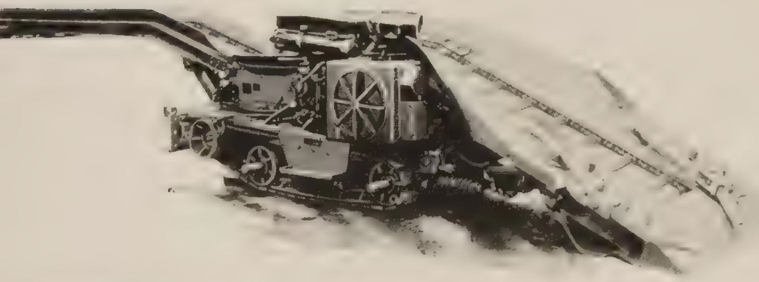

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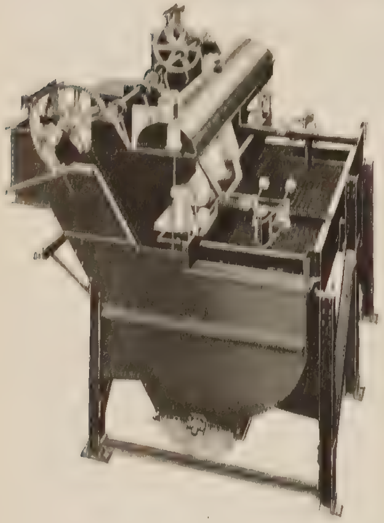

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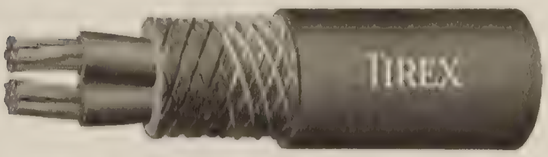

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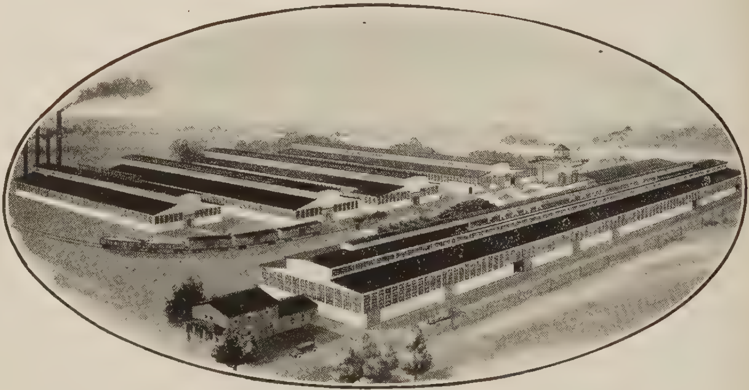

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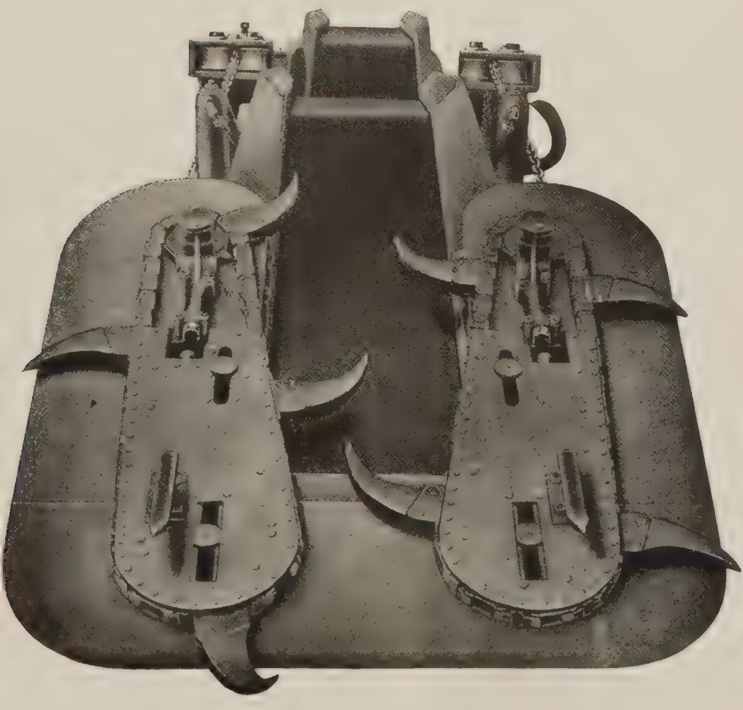

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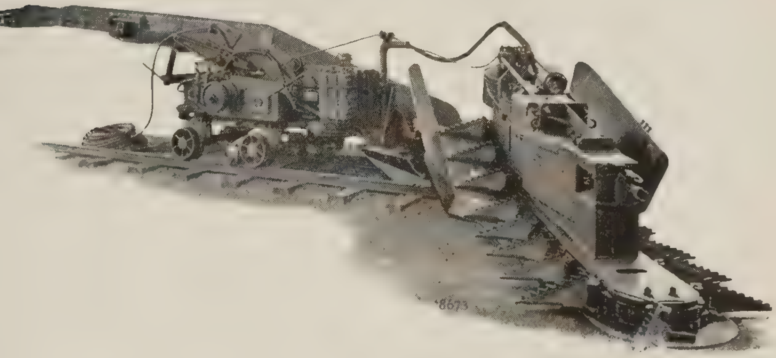

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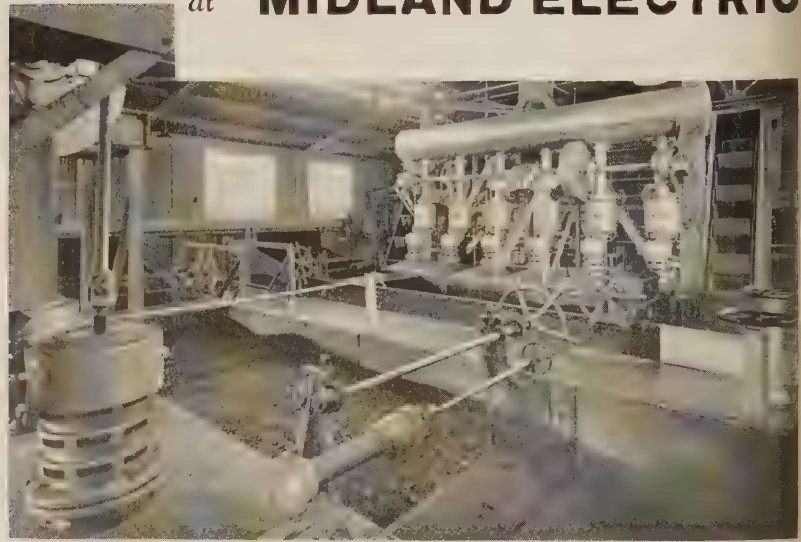

Link-Belt Products Include:

Complete Coal Tipple Equipment. Link-Belt Simon-Carves Washeries, Dry Cleaning Equipment, Dust Extraction Equipment, Elevators and Conveyors of all Types. Screens (Vibrating, Shaking, Revolving, etc.) Picking Tables, Loading Booms, Feeders, Crushers. Car Dumpers. Chains (Malleable Iron, Promal or Steel), Shovels, Cranes, Draglines. Positive Drives: Silent Chains; Silverlink Roller Chain; Speed Reducers; P. I. V. Gear Variable Speed Transmission. Complete line of Accessories.

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4884

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20-Ton, Three Motor, Haulage Locomotive with Loads.

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Two to Thirty Tons

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Open—Enclosed—Government Approved
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Little Giant 700 Type Mounted Coal Drill

The Little Giant "One-Man" Mounted Coal Drill

The famous "472" Little Giant Electric Coal Drill can now be furnished with the improved post mechanism shown in the illustration. Operator places drill on turntable and lifts to desired drilling height while a ratchet automatically engages the notches in the post as the drill is raised. When the operator stops lifting, the ratchet and notch hold the drill in place while a hand set-screw is tightened. One man does it all—EASILY!

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1 The Timken Tapered Roller Bearing embodies certain elements of design that are essential to maximum performance in mine car wheels, not found in other bearings. One of these important features is Timken positive roll alignment which prevents the rollers skewing both when in and out of the load zone. Another is the correct spacing of the rollers, with a truly perforated cage, preventing roller to roller contact and reducing internal friction to the vanishing point.

2 Timken Tapered Roller Bearings are made of Timken alloy steel, a special steel produced in Timken's own steel mill under the direct supervision and control of Timken metallurgists and engineers. This material is largely responsible for the greater load carrying capacity, endurance and long life of Timken Bearings.

3 The Timken Roller Bearing Company originated the tapered roller principle 35 years ago and has had more engineering experience in applying anti-friction bearings to mine cars than any other bearing manufacturer.

4 The Timken mine car bearing mounting includes an all-steel dust collar **shrunk-on** the axle—a patented feature developed for your benefit. This protects the bearing against the side-wise pounding of the loaded car, preventing it from being forced out of adjustment. The shrunk-on dust collar will not turn on the axle, thus eliminating the usual axle wear at the shoulder which would of course be disastrous to the bearing. It forms a permanent seal against the ingress of dust, grit and water and prevents the escape of lubricant. Make sure of getting this vital feature when buying bearings or cars.

5 Over 1,000 mine operators have proved the dependability and economy of Timken-equipped mine cars during years of profitable service.

6 All the leading mine car builders install and recommend Timken Tapered Roller Bearings, because they know Timken is strong enough to stand back of each installation regardless of size.

7 The entire engineering, financial and manufacturing resources of the Timken Roller Bearing Company are behind every Timken Bearing that goes in a mine car to assure the operators satisfaction. Don't experiment; specify Timken-equipped—it pays.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

STEEL
or Coal Mine Use

WHEN the mines need steel for maintenance or new construction, quick service is essential Whether it is a large quantity or only a bar, a sheet or a few bolts, your
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Clutched swing and hydraulic lift mechanisms.

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Cutler-Hammer drum controllers and magnetic circuit breakers.

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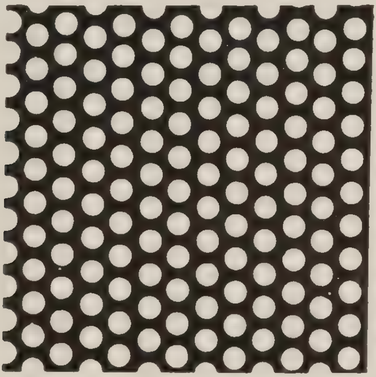

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Feed and Hammer Mills

. . . and many other purposes

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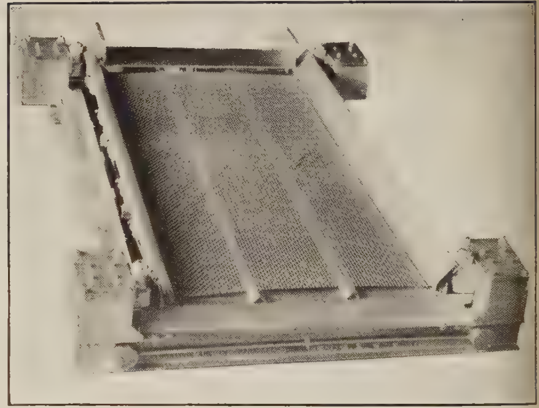

By no other means can you screen damp coal in fine sizes and get the tonnage and efficiency shown by the Type 400 Screen!

CAPACITY:

4′ x 8′ SCREEN

3/8″ *Separation*

Feed — 1¼″ slack, 50% — 3/8″

Moisture — damp.

Tons per hr. { 200 T. per screen.
6.3 T. per sq. ft.

Tailings Product		
	+ 3/8″ Coal,	92.0%
	Near Mesh Undersize,	6.2%
	— 1/8″ "	1.8%
		100.0%

*10-Mesh Separation**

Feed — 5/16″ slack, 31% — 10-mesh.

Moisture — damp.

Tons per hr. { 86 T. per screen.
2.7 T. per sq. ft.

Tailings Product		
	+ 10-mesh coal,	93.6%
	Near Mesh Undersize,	4.7%
	— 20 " "	1.7%
		100.0%

FEATURES:

VIBRATOR AT EACH CORNER!
INTENSE VIBRATION OF ENTIRE SURFACE!
EQUAL DISTRIBUTION OF POWER OVER ENTIRE SCREEN AREA!
NO LUBRICATION!

A PRACTICAL MEANS OF DE-DUSTING — A NEW SOURCE OF PROFIT!

* The Type 400 has made it possible for the first time to eliminate the undesirable dust from household stoker coal by screening at 10 mesh in combination with air separation.

Operators interested in producing coal for this or other purposes are invited to write for further information.

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Switch Materials
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Trucks Complete
Wheels plain and equipped with Timken Bearings, Ball Bearings, Hyatt Bearings; Journal Boxes Axles, Channels, Bumpers, Body Irons.

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Because Flexipipe brings pure air to working faces, shafts, slopes, and entries, it makes men more efficient—and that means economy.

And because it clears the air at the working face 5 minutes after shooting, it saves time—which is MORE efficiency and economy.

Write for reasons why Flexipipe is the standard auxiliary ventilating system in coal mines.

BEMIS BRO. BAG CO.

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Here are just a few of the many devices designed by General Electric to help you reduce operating costs.

Save with dependable, trouble-free G-E motors. Thousands of installations prove the confidence that has been placed in these modern drives.

Save by modernizing with G-E control to provide maximum safety and protection. Perfectly matched motor and control combinations promote economy and efficiency.

Save by lighting those hard-to-light places with the G-E Handy floodlight. It's inexpensive and easy to install.

Save with arc welding. The G-E arc welder will save broken machinery from the scrap heap and get it back into service in record time.

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Consider also the advantages of G-E equipment as applied to modernized ventilation, pumping, power generation and distribution, and to the many devices of mechanized mining. Let G-E engineers help plan your cost-cutting campaign. General Electric Company, Schenectady, N. Y.

200-591D

ENERAL ELECTRIC

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. . . . a new contribution for added safety and convenience in electric blasting.

In the Accordion Fold the leg wires are folded Accordion-wise around the Blasting Cap to cushion and protect it. The resulting package occupies small space. The wires unfold naturally avoiding kinks and snarls. This exclusive Atlas package is handy to carry and handy to use.

Atlas maintains complete facilities for the manufacture of Blasting Powder, High Explosives and Blasting Accessories to serve Illinois Mining needs.

A Proper Explosive for Every Blasting Requirement.

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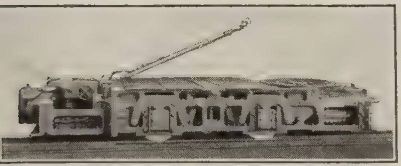
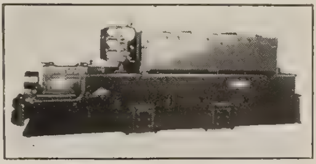

4-ton trolley gathering locomotive.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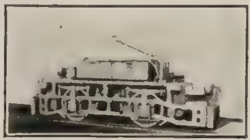
10-ton combination trolley and storage battery haulage locomotive.

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38-ton 3-motor trolley haulage locomotive.

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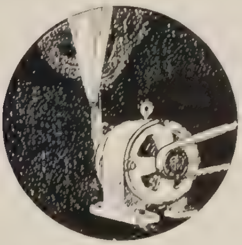
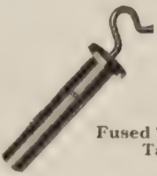
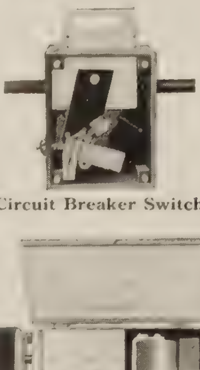


If Motors Could WHISTLE!

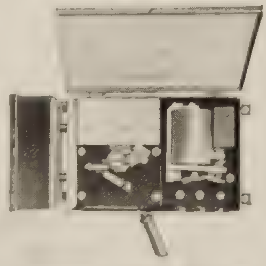
IF electric motors could whistle, or blow off steam the way boilers do when overloaded, there would be no reason to use safety and control devices. But, because a burned-out motor is an expensive signal, mine operators everywhere have found it profitable to include O-B circuit breakers, fused trolley taps and automatic motor starters in their standard equipment specifications. These inexpensive devices, which protect and safeguard men and costly machinery, pay for themselves quickly; then continue to increase savings. Without such protection, maintenance, replacement and lost time costs cut heavily into an already small margin of profit.



Fused Trolley Tap



Circuit Breaker Switch



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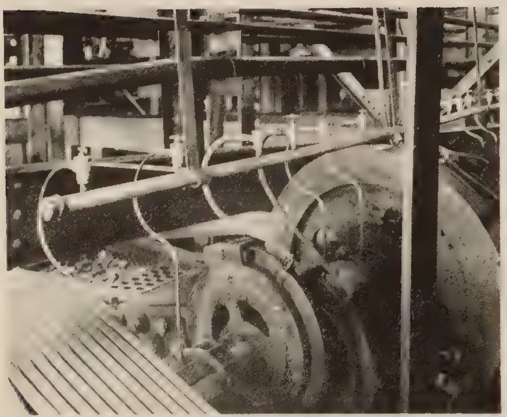
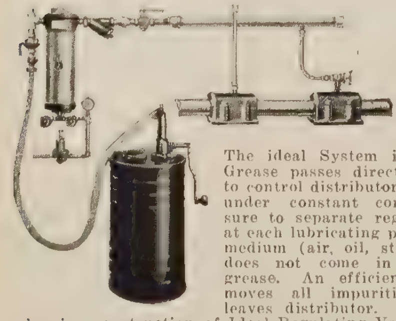


Typical application of Ideal Mechanized Lubrication to eccentric bearings of reciprocating drive for shaker screens in anthracite coal breaker.

Ideal Lubrication applied to Shaking Screen Drives in a modern Pennsylvania coal preparation plant of large Bituminous Producer.



The ideal System in a nut-shell. Grease passes directly from drum to control distributor, and is forced under constant continuous pressure to separate regulating valves at each lubricating point. Pressure medium (air, oil, steam or water) does not come in contact with grease. An efficient strainer removes all impurities as grease leaves distributor. Patented non-clogging construction of Ideal Regulating Valves makes accurate regulation easy, and assures uniform flow of grease as long as adjustment remains unchanged.

Coal Operators . .
Save Money Through "Ideal" Lubrication

Correct Lubrication is an extremely important factor in the efficient operation of modern coal handling and coal preparation plants, and progressive coal companies everywhere are not only **cutting costs** but also **increasing production** through the use of "Ideal" constant-feed controlled lubrication. Most modern plants and many others, are partly or entirely equipped with the "Ideal" System. Some of the big advantages thereby secured, are:

An Average Saving of 70% in Lubricant Expense

By applying the proper amount of grease **continuously,** instead of applying excessive amounts intermittently, astonishing savings have been achieved. On a large set of crushing rolls, for instance, the amount of grease consumed was reduced from 100 lbs. per day to 40 Other reports show savings of from 30% up, the savings from all installations reported averaging about 70%. Another important advantage secured through correct continuous lubrication is greater cleanliness and reduced fire hazard.

Power Costs Reduced 12½%

Careful tests by one progressive coal company showed that after applying Ideal Lubrication to its shaker screens, 17½% less power was required for starting, and 12½% less for continuous operation. Because Ideal Lubrication once installed and adjusted is practically infallible, the actual savings in power cost over a long period of operation are probably even greater than during a limited test period.

Bearing Replacements Practically Eliminated

The continuous supply of pure grease delivered by the Ideal System at constant pressure to every bearing; and the outward flow principle which automatically keeps out dust, water, and all other impurities from the bearing surfaces, practically eliminate the maintenance expense ordinarily caused by lack of proper lubrication. Figures furnished by users of the Ideal Lubricating System show an average saving of 94% in labor and material costs for repairing and replacing bearings.

IDEAL LUBRICATOR COMPANY PACKARD BDG. PHILADELPHIA, PA.

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2880 men wearing Hy-Test Shoes reduced foot injuries 50% in large mine

ctual Statement by Safety Director of Large Mining Company:

year ago my ambition was to get all r men into Hy-Test Safety Shoes thin a period of two years. Now, at e end of the first year, 90% of our en are so equipped. The result is our ot accidents have been reduced 50%. e employ 3200 men."

Just one of the actual cases of definite savings in time and money that Hy-Test Safety Shoes have accomplished for leading industrial concerns the country over.

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SAFETY SHOES
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PROCEEDINGS
OF THE
ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY 1892

1934

GEO. D. LOUDEN PRINTING COMPANY
Champaign, Illinois

PROCEEDINGS
of the
ILLINOIS MINING INSTITUTE

Founded February, 1892

1934

Summer Meeting
on Board S. S. Cape Girardeau
June 8-9-10

and

Annual Meeting
SPRINGFIELD, ILLINOIS
November 2

Harry A. Treadwell

President, 1934

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1892-3	James C. Simpson, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
1893-4	James C. Simpson, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
1894-5	Walton Rutledge, State Mine Inspector, Alton, Ill.
1895 1911	Institute inactive.
1912-3	John P. Reese, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1913-4	Thomas Moses, Supt., Bunsen Coal Co., Georgetown, Ill.
1914-5	J. W. Starks, State Mine Inspector, Georgetown, Ill.
1915-6	William Burton, V. P., Illinois Miners, Springfield, Ill.
1916-7	Fred Pfahler, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1917-8	Patrick Hogan, State Mine Inspector, Carbon, Ill.
1918-9	William Hall, Miners Examining Board, Springfield, Ill.
1919-20	William Hall, Miners Examining Board, Springfield, Ill.
1920-21	Frank F. Tirre, Supt., North Breese Coal & Mining Co., Breese, Ill.
1921-22	Prof. H. H. Stoek, Mining Dept., University of Illinois.
1922-23	John G. Millhouse, State Mine Inspector, Litchfield, Ill.
1923-24	D. D. Wilcox, C. E., Superior Coal Co., Gillespie, Ill.
1924-25	H. E. Smith, Gen. Supt., Union Fuel Co., Springfield, Ill.
1925-26	E. G. Lewis, Supt., Chicago-Sandoval Coal Co., Sandoval, Ill.
1926-27	Wm. E. Kidd, State Mine Inspector, Peoria, Ill.
1927-28	James S. Anderson, Supt., Madison Coal Corp., Glen Carbon, Ill.
1928-29	John E. Jones, Safety Engineer, Old Ben Coal Corp., West Frankfort, Ill.
1929-30	Prof. A. C. Callen, University of Illinois, Urbana, Ill.
1930-31	Joseph D. Zook, Pres., Illinois Coal Operators' Assn., Chicago, Ill.
1931-32	Geo. C. McFadden, Asst. Vice-Pres., Peabody Coal Co., Chicago, Ill.
1932-33	Chas. F. Hamilton, Vice-Pres., Pyramid Coal Co., Chicago, Ill.
1933-34	Harry A. Treadwell, Gen. Supt., C. W. & F. Coal Co., Benton, Ill.

A WORD TO THE MEMBERS FROM THE SECRETARY

I doubt whether our members realize the tremendous amount of work connected with getting together the year-book which is presented herewith. Probably none of the members have ever stopped to consider what is necessary to make this book possible.

First of all, we are dependent upon the suppliers for advertisements in order to defray the expenses of the year-book. This is our sixth issue. Many of the advertisers have contributed to each issue, and we feel that the users of equipment would assist the Institute very materially if they would give due consideration to the suppliers whose advertisements appear in the advertising section in the back of this book, whenever in need of equipment and supplies.

It will be of great assistance for future issues if you will patronize our supporters, the advertisers, whenever possible. The success or failure of this publication and the issuance of future editions will depend greatly on this assistance.

OUR RIVER TRIP

We've done a lot of grumblin' and a cussin' of our luck,
And talked of rotten business and the President gettin' stuck,
But when we get our notice that the River Trip is near,
We push all other things aside and the world seems full of cheer.

'Tis then we tell our bosses of the business we will lose
If we fail to take this river trip or do not pay our dues,
And then the sun begins to shine as the cashier writes a check,
For we know our feet will once more hit the Cape Girardeau's deck.

For sixteen years we've sailed these shores with Happy Captain Buck,
And made each port along the way from Thebes to Keokuk.
We always meet some dear old friends and make some new ones too,
And mine more coal, if talking counts, than all the miners do.

Our business sessions, held on deck, are interesting, indeed,
As almost every mining man hears something he should heed.
Good papers and discussions are given us each day,
By able minded mining men who know just what to say.

To those who take these river trips, there's nothing to be said
About the jovial times we've had, from supper-time till bed.
You either join a game of cards or talk with those you've met,
Or listen to "Sweet Adeline" by some barber-shop quartette.

And then our midnight lunch is spread, with sausages galore,
With beans and cheese and hard-boiled eggs; you'd never ask for more.
Of course, there's always hot-dogs, both rubber and of meat,
With coffee, which is good and hot, it surely is some treat.

Then, when our trip is ended and the dock is drawing near,
We gather on the forward deck and this is what we hear:
"Good-bye Harry, good-bye Bael," farewell is the cry,
Be sure to make the trip next year, on the good boat I. M. I.

J. A. ("JEFF.") JEFFERIS.

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SUMMER MEETING AND BOAT TRIP

June 8-10, 1934

Annual Summer Meeting and Boat Trip of the Illinois Mining Institute eld on S. S. Cape Girardeau, leaving St. Louis Friday, June 8, 1934, at 0:30 p. m., and returning to St. Louis Sunday, June 10, 1934, at 8:30 a. m.

MORNING SESSION

Meeting called to order at 9:45 a. m., Saturday, June 9, 1934, by Harry A. Treadwell, President.

Harry Treadwell: It is very much of a pleasure this morning to greet the nembers of this Institute, and it is very gratifying to find 113 at this meeting oday that are actively interested in the coal business and the operation of he Institute.

As we have quite a little business and quite a long program, I believe we hould get started on it. As the yearbook is out and the minutes are in it, ve can dispense with the reading of the minutes. So we will now have the oll call by the Secretary and will ask everyone to stand up as his name is alled.

ATTENDANCE

ILLINOIS MINING INSTITUTE SIXTEENTH ANNUAL BOAT TRIP

St. Louis, Down the Mississippi River, and Return

June 8-9-10, 1934

ADAMS, W. C.	Koppers-Rheolaveur Co., Pittsburgh, Pa.
ADAMSON, C. H.	Stephen-Adamson Mfg. Co., Chicago, Ill.
BARLOW, J. E.	Goodman Mfg. Co., Springfield, Ill.
BARTLETT, A. G.	Austin Powder Co., West Frankfort, Ill.
BASKIN, E. D.	**Upson-Walton Co., Chicago, Ill.**
BELTZ, J. S.	**Jeffrey Mfg. Co., Columbus, Ohio**
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BERGFELD, R., JR.	Vacuum Oil Co., St. Louis, Mo.
BLAKE, ARTHUR	Peabody Coal Co., Marion, Ill.
BLANKINSHIP, G. F.	Egyptian Iron Works, Murphysboro, Ill.
BREWSTER, BURT B.	Webster Groves, Mo.
CARGAL, GORDON	Jeffrey Mfg. Co., Herrin, Ill.
CARTER, DALE	Bell & Zoller Coal & Mining, Zeigler, Ill.
CHINN, ERWIN	Franklin County Coal Co., Royalton, Ill.
CHRISTIANSON, C.	Sullivan Machinery Co., Mt. Vernon, Ill.
CLARK, FRED K.	Hulburt Oil & Grease Co., St. Louis, Mo.
COFFEY, E. J.	**Binkley Coal Co., St. Louis, Mo.**
COLCLESSER, R. Y.	E. I. duPont deNemours Co., Terre Haute, Ind.
COOK, WALTER	Central Mine Equipment Co., Webster Groves, Mo.
DAVIS, W. H.	Simplex Wire & Cable Co., Decatur, Ill.
DAWSON, HUGH	Bethlehem Steel Co., Herrin, Ill.

DAY, SAM	Clarkson Coal Mining Co., Nashville, Ill.
DODD, A. F.	U. S. Fuel Co., Danville, Ill.
DOUGHERTY, JAMES	Bell & Zoller Coal & Mng. Co., Zeigler, Ill.
EDMUNDSON, RAY	United Mine Workers, Benton, Ill.
EVANS, JOHN H.	Wasson Coal Co., Harrisburg, Ill.
FARNSWORTH, NAT	West Virginia Coal Co., Gillespie, Ill.
FIRMIN, WALTER H.	Joyce-Watkins Co., Metropolis, Ill.
FLEMING, J. B.	Mine Safety Appliances Co., Urbana, Ill.
FOSTER, JOHN R.	C. W. & F. Coal Co., West Frankfort, Ill.
GARCIA, JOHN A.	Allen & Garcia Co., Chicago, Ill.
GARWOOD, THOMAS	C. W. & F. Coal Co., West Frankfort, Ill.
GIVEN, IVAN A.	"Coal Age," New York, N. Y.
GRISSOM, J. FRANK	Aluminum Ore Co., Belleville, Ill.
HALBERSLEBEN, PAUL	Sahara Coal Co., Harrisburg, Ill.
HALL, L. W.	Goodman Mfg. Co., St. Louis, Mo.
HAMILTON, C. F.	Pyramid Coal Co., Chicago, Ill.
HARTWELL, LEN	Pyramid Coal Co., Pinckneyville, Ill.
HARVEY, HADLEY	Ohio Brass Co., Evansville, Ind.
HELSON, JAMES R.	Metropolis, Ill.
HERRINGTON, M. K.	Dept. Mines & Minerals, Springfield, Ill.
JEFFERIS, J. A.	Ill. Term. Ry. System, St. Louis, Mo.
JOHNSON, E. H.	Sullivan Mchy. Co., Chicago, Ill.
JONES, ARCH M.	John A. Roebling's Sons Co., St. Louis, Mo.
JONES, JOHN E.	Old Ben Coal Corp., West Frankfort, Ill.
JONES, WALTER M.	Joy Mfg. Co., Franklin, Pa.
JOY, DEWEY	Sullivan Mchy. Co., Chicago, Ill.
JOY, JOSEPH	Sullivan Mchy. Co., Chicago, Ill.
KINSMAN, HENRY	Franklin County Coal Co., Royalton, Ill.
KNOIZEN, A. S.	Joy Mfg. Co., Franklin, Pa.
LEIGHTON, M. M.	State Geological Survey, Urbana, Ill.
LEMING, ED	Union Colliery, Dowell, Ill.
LINDSAY, W. L.	Vacuum Oil Co., Benton, Ill.
LONG, JOSEPH A.	Jeffrey Mfg. Co., Terre Haute, Ind.
MacVEAN, GORDON	Mine Safety Appliances Co., Pittsburgh, Pa.
MALSBERGER, A. H.	DuPont Powder Co., Springfield, Ill.
MARSH, I. D.	Alcoa Ore Co., Belleville, Ill.
MARTIN, ENOCH	Dept. Mines & Minerals, Springfield, Ill.
MILLER, FRED	Franklin County Coal Co., Herrin, Ill.
MILLER, JAMES	Mines Equipment Co., St. Louis, Mo.
MILLHOUSE, JOHN G.	Litchfield, Ill.
MITCHELL, D. R.	University of Illinois, Urbana, Ill.
McFADDEN, GEO. C.	Peabody Coal Co., Chicago, Ill.
McREAKEN, C. W.	Peabody Coal Co., Marion, Ill.
NIEDRINGHAUS, RAY	A. Leschen & Sons Rope Co., St. Louis, Mo.
O'BRIEN, FRANK	American Cable Co., Harrisburg, Ill.
OEHM, KARL	Sahara Coal Company, Harrisburg, Ill.
O'ROURKE, JOHN	C. W. & F. Coal Co., West Frankfort, Ill.
O'ROURKE, PETE	Wm. Hales Co., West Frankfort, Ill.

O'TOOLE, COL. E.	American Coal Cleaning Co., Welch, W. Va.
PFAHLER, F. S.	Superior Coal Co., Chicago, Ill.
PHILLIPS, E. R.	Tyson Roller Bearing Co., Massillon, Ohio
PICKARD, A. E.	Mt. Vernon Car Co., Mt. Vernon, Ill.
POWERS, F. A.	Dooley Bros., Peoria, Ill.
PRITCHARD, W.	Goodman Mfg. Co., St. Louis, Mo.
REUTER, WM.	Peabody Coal Co., Marion, Ill.
RHINE, FRANK	Duncan Foundry & Mch. Co., Alton, Ill.
RICHART, F. W.	General Electric Co., Carterville, Ill.
RODENBUSH, JOHN	C. W. & F. Coal Co., West Frankfort, Ill.
ROMAN, FRANK	Hercules Powder Co., Chicago, Ill.
SACKBAUER, L. A.	Missouri Pacific Ry., St. Louis, Mo.
SANDOE, C. J.	W. Va. Coal Co., St. Louis, Mo.
SCHONTHAL, B. E.	B. E. Schonthal & Co., Chicago, Ill.
SCHULL, B. H.	Binkley Mining Co., Clinton, Ind.
SCHULL, FRANK	Binkley Mining Co., Clinton, Ind.
SCHUMACHER, H. J.	Joyce-Watkins Co., Chicago, Ill.
SCOTT, G. W.	Timken Roller Bearing Co., St. Louis, Mo.
SCULLY, T. ALVIN	State Mine Inspector, Troy, Ill.
SHACKELFORD, N. P.	Friedman-Shelby Shoe Co., St. Louis, Mo.
SKINNER, S. E.	Standard Coal Co., Wheatland, Ind.
SMITH, C. M.	University of Illinois, Urbana, Ill.
SPICER, CHAS. B.	Hercules Powder Co., St. Louis, Mo.
STARKS, J. W.	Peabody Coal Co., Taylorville, Ill.
STEIGER, A. E.	Pyramid Coal Co., Pinckneyville, Ill.
STELLING, H. C.	Union Carbide Co., New York, N. Y.
SUTHERLAND, H. T.	Standard Oil Co., Marion, Ill.
SUTOR, DON M.	Sullivan Mchy. Co., St. Louis, Mo.
SYERS, JACOB	Western Powder Co., Peoria, Ill.
THIES, HENRY	Portable Lamp & Equipt. Co., Pittsburgh, Pa.
THOMPSON, J. I.	Koppers-Rheolaveur Co., Pittsburgh, Pa.
THOMPSON, ROBERT	Hercules Powder Co., Chicago, Ill.
TIRRE, FRANK	Better Business Bureau, St. Louis, Mo.
TOBIN, HOWARD	Coal Stripping Co., Pinckneyville, Ill.
TREADWELL, H. A.	C. W. & F. Coal Co., Benton, Ill.
VLASAK, JOSEPH	St. Louis & O'Fallon Coal Co., Caseyville, Ill.
WEART, EVERETT T.	John A. Roebling's Sons Co., Chicago, Ill.
WIEDERANDERS, E. O.	Jeffrey Mfg. Co., Springfield, Ill.
WILKEY, FRED S.	Ill. Coal Oper. Assn., Chicago, Ill.
WILSON, J. C.	Ohio Brass Co., Mansfield, Ohio
WOOSLEY, C. W.	Pyramid Coal Corp., Pinckneyville, Ill.
WRIGHT, D. D.	Cent. Ill. Pub. Serv. Co., Marion, Ill.
WYLAND, RAYMOND	American Coal Clng. Co., Welch, W. Va.
YOUNG, WM. P.	Crescent Mining Co., Peoria, Ill.

Harry Treadwell: Next we will have the report of the different committees and will hear first from Mr. Hamilton, Chairman of the Scholarship Committee.

(Mr. Hamilton reads paper giving report of Vocational Training Committee).

REPORT OF VOCATIONAL TRAINING COMMITTEE

Chicago, Illinois, June 5th, 1934.
Mr. Harry A. Treadwell, President,
Illinois Mining Institute.

Members of the Institute.

Dear Sir and Gentlemen:

At the annual meeting of the Institute held at Springfield on November 3, 1933, a motion prevailed for the appointment of a Committee of five to inquire into and arrange for considering an appropriation for a scholarship in Mining Engineering at the University of Illinois. This Committee has had four meetings.

At the first meeting Mr. George F. Campbell was appointed as a Sub-Committee to contact and secure all possible information regarding the establishment of scholarship at the University of Illinois. The result of his efforts is given in the following communications:

"Dr. Arthur H. Daniels, Acting President, University of Illinois, Urbana, Illinois.

Dear Dr. Daniels:

I have just been advised by one of the executives of the Illinois Mining Institute that they want to establish a scholarship at the University of a value not to exceed $500 per annum.

Their plan, I think, is to create a trust fund, the income from which will provide the necessary funds. They want to do this in connection with our School of Mining Engineering at the University. I think they will want to make the deposit with us in trust, to be operated by the University in accordance with their plans. I told them I would get them the full details with regard to it.

While I did not discuss that detail, I imagine they will want to deposit with us enough gilt-edge securities to provide the fund, same to be administered by us.

What would be the cost and method of administration of a fellowship in mining engineering instead of a scholarship?

Very truly yours,
(Signed) WALTER W. WILLIAMS."

"Hon. Walter W. Williams, Benton, Illinois.

Dear Mr. Williams:

This is in reply to your letter of May 4, concerning the plan of the Illinois Mining Institute to establish a scholarship at the University of Illinois of a value not to exceed $500.00 per annum.

Scholarships are usually awarded for distinction or achievement in scholarship and ordinarily do not carry with them any obligation to render service. Fellowships are frequently awarded to persons who are expected in return to do research work in a certain field. Sometimes they are called research fellowships or research assistantships. We prefer to call such positions research assistantships when the funds are supplied to further research work.

The University has not made any charge against trust funds established for scholarships and fellowships, so that there would not be any cost in administering the proposed Illinois Mining Institute's trust. You also ask what would be the method of administration. It is customary to leave the selection of the recipients of such awards to the University.

The department in which the research vork is done makes nominations to uch fellowships or research assistanthips in the same way as it recomnends persons for appointment to he staff. If the Illinois Mining nstitute will indicate in general erms the purposes for which it vishes to endow a fellowship we shall e glad to supply its officers with ny further information they desire. Perhaps the following statute of the Board of Trustees should be called o the attention of the Institute:

Merging of Gift Funds

Every donation to the University n a sum of $5,000 or less, for the urpose of providing a fund, the nnual income of which shall be used or a purpose designated by the donor, if accepted, shall be accepted with he condition and proviso that the apital sum of the fund thus estabished may, after the lapse of twenty-ive years, be merged with other apital funds given to the University or similar purposes.

When any donation or donations o the University are thus merged, he record of the consolidated fund hall indicate the names or titles of he smaller funds so consolidated.

Since the Institute wishes to proide an income of $500.00 per annum assume that the above provision will ot apply to its trust fund since an ncome of $500 per year would reuire an endowment of at least $10,000.

If I have not covered all of the uestions you had in mind, please et me know and I shall be glad to ive you any additional information ou may desire.

Cordially yours,
(Signed) ARTHUR H. DANIELS,
Acting President."

At the next meeting the Committee decided that the Institute at this time did not have sufficient funds to establish either a scholarship or fellowship at the University, and further that the establishment of either a scholarship or fellowship was a matter for more extensive study and consideration.

It then gave consideration to either a Safety Contest in the state, or an Essay Contest on SAFETY by the school children of the state. The latter idea seemed to prevail and the following data was secured from the National Safety Council.

The National Safety Council will conduct, on behalf of the Illinois Mining Institute, an Essay Contest for a sum not to exceed $100.00. In explanation, we wish to add that the National Safety Council is an association operating without profit and is only charging the actual out-of-pocket expense, plus an estimated amount for the services of its organization, which will be used in this work.

The committee, therefore, recommends that the Institute appropriate the sum of $350.00 for use in an Essay Contest for the year 1934, to be conducted by the National Safety Council on behalf of the Illinois Mining Institute under the following general plan:

1. Subject: Why should coal miners be interested in Safety?
2. No Essay shall exceed 500 words.
3. Eligible pupils of the Fifth, Sixth, Seventh and Eighth Grades, who are fourteen years of age or less, and who attend schools within the State of Illinois and within the counties and districts in which coal is mined are eligible to compete in this contest.

4. Closing of Essays should be submitted to School Principals on or before October 20, 1934.

5. Originality of thought, clearness of expression, and truthfulness of facts will be considered in making awards.

6. Prizes:

a. Best essay in the state, $25.00.

b. Second best essay in the state, $15.00.

c. Third best essay in the state, $10.00.

d. Each of the ten next best essays in the state, $5.00 each.

e. Best essay in each district (approx. 20 dist.), $4.00 each.

f. Second best essay in each district (approx. 20 dist.), $2.00 each.

7. No pupil will be eligible for more than one prize.

8. Selection: No more than four essays will be submitted to the National Safety Council from any one school. It is suggested that each school select one essay from each of the four grades (5th, 6th, 7th and 8th).

9. The four best essays from each school shall be selected by the School Principal, or in some manner designated by him or her.

10. Contest Judges: The judges in this contest shall be the President of the National Safety Council, the President of the Illinois Mining Institute, and the Director of the Department of Mines and Minerals, State of Illinois.

Your Committee further recommends that a new committee of three be appointed to cooperate with the National Safety Council in arranging further details for this contest, and that another committee of three be appointed to further investigate the question of scholarship or fellowships at the University of Illinois.

Respectfully submitted,
GEORGE F. CAMPBELL.
J. M. JOHNSTON.
L. D. SMITH.
H. H. TAYLOR, Jr.
C. F. HAMILTON, Chairman.

Harry Treadwell: You have heard the report of the committee. Are there any comments on it?

E. H. Johnson: Do I understand that it is not possible for the Institute to contribute any help to some chap whom they might wish to aid?

C. F. Hamilton: Yes, that is the situation as it now stands. We thought we could try this essay contest and at the end of the contest the committee could make what other recommendations they wanted.

E. H. Johnson: I think the essay contest is a good idea, but would it not be possible to figure out some way so that we could help out some fellow whom we think deserving?

C. F. Hamilton: It would be possible to do that, but I think the Institute is taking a chance in establishing this scholarship. The one we select may decide he does not want to finish his education. And if the boy does go through his college work he may want to change to something else. It would seem that if the Institute were to establish this scholarship they should have the directorship of the class of work to be taken. We all thought we should have more time to study the whole problem.

D. R. Mitchell: I think the committee has done the right thing in taking more time to think this over. I do believe that President Daniels may have got the wrong slant on just what was wanted. In fact the students who are working their way through school, if they can get enough for their fees, are the ones we want to help. But there are a great number of angles to this thing, and I believe the committee did right by taking more time in thinking it over. We get but very few boys from the mining regions who follow or want to enter into mining work, and I think the type of man to be selected for work of this kind should be given much thought.

(Motion made and seconded that he recommendations of the committee be accepted. Motion carried unanimously.)

Harry Treadwell: As Mr. Thomas, Chairman of Appropriation for Mineral Industry Research Committee, is not with us, will ask Dr. Leighton to give us some idea of what has been done along this line.

Dr. M. M. Leighton: You will remember that last Fall your attention was called to the fact that the Mineral Industry Research that was beng carried on at the University of Illinois was handicapped because of ack of funds and the idea of providing for Mineral Industry Research was brought out at this last meeting. A part of the research work has been carried on in several ways in temporary laboratories at the University for he last two and one-half years.

The matter was also called to your attention at our last session in Springfield last Fall, that these laboratories are very poorly housed, and a committee was appointed to look into this to see what could be done; he thought being that this planning would not in any way displace the work already started, but rather add o it.

T. J. Thomas, Geo. N. Reed and Geo. B. Harrington went into this matter very carefully, and they pointed out that this was a very worthy cause. They were shown, however, where some 30% of the cost of such an appropriation could be borne by the Federal Government, but to take advantage of this, it would be necessary for the State of Illinois to deposit with the Federal Government bonds to cover the 30% to be advanced by the Federal Government, but the State of Illinois does not have any bonds to deposit, and consequently we would be unable to take advantage of this opportunity.

A report of a measure to provide for this work was made to the legislature, but nothing came of it. Mr. Thomas has been very active in this work, and the committee has done a lot of work to be sure that the measure would be the kind that the industry could find to be of the most value. So looking forward toward having a measure of this kind passed, a committee from the Operator's Association is co-operating with the Institute Committee together with the State Geological Survey to present a consolidated report on this measure.

Harry Treadwell: We will now have a report from the Membership Committee. As Mr. Herb Taylor is not on the boat, will ask our Secretary, Mr. Schonthal, to give this report.

B. E. Schonthal: We have had a very active, successful membership committee this year. We have secured 132 new members, and have also secured about 12 or 15 on this boat trip. We had 470 members up to this morning, and we will probably have about 485 members when this trip is over, as there are several on this trip who are not members, and we are going to sign them up.

Harry Treadwell: I will now turn the chair over to Mr. Hamilton, who will act as your Chairman for the morning session.

C. F. Hamilton: I am advised that the Program Committee has deemed it advisable and necessary to make a change in the program. Therefore the first paper we will have this morning will be "How Can Labor be Made to Realize Its Responsibilities for Prevention of Accidents?" by W. J. Jenkins. As Mr. Jenkins is not with us will ask Mr. Fred Wilkey to read his paper. The paper by Mr. Jones will be presented a little later in the morning session.

HOW CAN LABOR BE MADE TO REALIZE ITS RESPONSIBILITIES FOR PREVENTION OF ACCIDENTS?

By W. J. JENKINS

President, Consolidated Coal Co. of St. Louis

Mr. Chairman and Members of the Illinois Mining Institute: The subject assigned to me by your Program Committee is "How Can Labor Be Made to Realize Its Responsibility for Prevention of Accidents?"

When we are able to "get over" to our employees as a whole the acceptance of the truth, as expressed in a recent National Safety Council Poster, reading,

"It Takes Only a Few Minutes to
Get to the Hospital but a
Long Time to Come Back"

we will have gone a long way toward supplying the answer in connection with the subject under discussion. However, labor—including in some instances members of the supervisory staff—will ultimately recognize the truth set out in the poster just referred to.

When labor recognizes the fact and takes it seriously, that their individual happiness, as well as the welfare of their fellow employees is at stake, we may then anticipate another step forward toward the minimizing of causes, as well as a lowering numerically of the number of accidents whether or not they be of a serious nature.

"Familiarity with danger breeds contempt." This saying is peculiarly applicable to those engaged in operating coal mines, and only intelligent daily direction of the working force by our supervisory staff can bring about the acceptance of this truth.

It is surprising to learn how many of our employees accept as inevitable the superstition, "That major accidents occur in cycles of 3s." Should one be so unfortunate as to experience a major accident, the management should "tighten up" and insist upon an immediate strict observance and compliance with all Safety Rules and Practices to "stamp out" this and any other superstitious idea.

In connection with our own company—First Aid work has been accepted by our employes generally as having a bearing on their own individual welfare. When the thought that it should extend over and include a fellow worker, is likewise accepted, we shall, and not until then approach the time when labor will not only recognize but will acept their individual responsibility in connection with prevention of accidents.

The responsibility rests upon the mployer to determine accurately and npartially:

1st. Cause of accident.

2nd. Was it possible to prevent it rough means of proper uses of aterials to be supplied?

3rd. Was the employee qualified or the particular job? I mean menlly as well as physically.

4th. Was it due to non-observnce of "Safety Rules"? Was the jured employee cognizant of such ules?

So far as our own company is conerned a copy of each accident eaches me direct. The three quesons just mentioned are applied, for e purpose of determining whether e accident is due to the lack of afety Rules or to negligence on the art of anyone of our supervisors, aving always in view the avoidance repetitions under similar circumances.

An analysis of our accident record nuary 1, 1927, to date, shows:

Southern Illinois Mine No. 7 proiced 2,113,612 tons.

Central Illinois Mine No. 15 proiced 5,204,862 tons.

umber of Fatal Accidents at Herrin No. 7 4

umber of Fatal Accidents at Mt. Olive No. 15 8

Surface Employees

	Herrin	Mt. Olive
Mechanic -		
rsting Throttle lve on Hoisting gine	1	

Had the principles as outlined in e earlier part of this paper been in actice all underground fatal accints might possibly have been oided. The surface fatal I look on as unavoidable.

Fatal Accidents Underground Employees

	Herrin	Mt. Olive
Fall of Top Coal	1	
Fall of Face Coal	-	2
Fall of Slate	-	4
Total	1	6
Occupations		
Certificated Miners Making Places Safe, Mech. Ldg.	1	3
Certificated Miners, Hand Ldg.	-	1
Cutting Mach. Oper.	-	1
Cut. Mach. Helper	-	1
Total	1	6
Other Inside Fatal Accidents		
Trip Rider	1	
Timbering Shaft Bottom	1	-
Main Line Road Cleaner	-	1
Bottom Battery Charger	-	1
Total	2	2
Total All Fatal	4	8

Lost Time on Non-Fatal Accidents

During the 7¼ years in question our analysis develops the fact that there was a total loss in

Southern Illinois (Herrin Mine No. 7) of 6,806 Mine Days.

Central Illinois (Mt. Olive Mine No. 15) of 39,131 Mine Days.

A further analysis shows that the "Lost Time" includes:

Night Forces at Herrin	142 Days
At Mt. Olive	421 Days
Top Crews at Herrin	389 Days
At Mt. Olive	1,581 Days
Miscellaneous at Herrin	707 Days
At Mt. Olive	8,292 Days

There was produced for each "Mine Day" loss:

At Herrin Mine ---------- 310 Tons

At Mt. Olive Mine ------- 133 Tons

Contrary to the earlier views of many, the introduction of mechanical loading devices resulted in a larger volume of mined tonnage per compensable accident as compared to Hand-Loading methods.

The result following which takes into consideration Cutting, Drilling, Shooting, Loading, Timbering, Track-Laying and in fact, all labor including repairs to Drilling, Loading and Cutting Machines, the transportation of the coal between the face and the parting, and representing as it does 75% of those employed underground on a work day, proves conclusively that the introduction of mechanical devices has actually reduced the hazard to all such classified workers.

Tonnage Produced Per Compensable Accident

Face to Parting at Mt. Olive No. 15 Mine

All Hand Loading, year 1927 ---------------5,252 Tons

Hand Loading and Some Conveyor Loading, year 1928 ---------------5,685 Tons

Mine equipped with Mechanical Loading as of November, 1929.

	Tons
Mechanical Loading 100%, Year 1930	10,600
Mechanical Loading 100%, Year 1931	17,064
Mechanical Loading 100%, Year 1932	19,790
Mechanical Loading 100%, Year 1933	14,931
Mechanical Loading 100%, First Quarter 1934	16,815

Face to Parting at Herrin No. 7 Mine

This mine, which was equipped with Mechanical Loaders during the year 1931, produces 90% of the tonnage, and Loading 10%.

	Comparisons		Average
Year 1931	Mech. Ldg. 12,514 Tons	Hand Ldg. 6,768 Tons	10,909 Tons
Year 1932	Mech. Ldg. 25,811 Tons	Hand Ldg. 7,755 Tons	21,514 Tons
Year 1933	Mech. Ldg. 20,976 Tons	Hand Ldg. 4,745 Tons	16,425 Tons
1st 5 Months 1934	Mech. Ldg. 24,744 Tons	Hand Ldg. 17,147 Tons	27,193 Tons
(100% Clear Record; No Accidents)			

A very commendable spirit of co-operation exists among many of our employees on the safety problem and to this we largely credit the reduced number of major or so-called Compensable Accidents.

C. F. Hamilton: Mr. Leming has prepared some interesting data on safety, which I will now ask him to give.

SAFETY SAVINGS CONTEST

By ED LEMING
Supt., Union Colliery Co., Dowell, Ill.

After being idle over two years the ine started operation in May, 1929. Iany of the men who started to work ad been unemployed during these wo years, some were new employees nd all were in positions and circumtances similar to new employees. Vithout any other apparent cause he cost of accidents was much too igh, costing 6c per ton for 1929.

Not only was the cost of accidents igh but due to the nature of the acidents the records looked very bad. Several fatal accidents and broken imbs were accounted for in this perid immediately after resuming opertions.

The officials were looking for some ew means of curbing the appalling najor accidents and also to reduce he cost due to these. The usual nethods of accident prevention were ot getting results. It was at this ime that the Safety Savings Contests vere started.

The mine is entirely on a mechancal loading basis and each section has ither one or two loading machines vith a foreman for the section. This llowed the men to be divided into groups very easily and each group vith its foreman was designated as a eam in the contest. These loading rews made eleven teams. In addiion to these, a team was composed of mechanics and the Chief Electriian. Another team was composed of he Motor Boss and his main line nen. Another team was made up of he Night Boss and his men. Two more teams were made up on top. A total of eighteen teams was ntered in the contests.

It was figured that 5c per ton was a standard cost for all expenses in connection with the prevention of accidents and the care and treatment of injured men. Hence it was proposed that if accidents could be reduced to a point that the cost would be less than 5c per ton the company would split the savings 50-50 with the men and foremen of the winning teams, that is, the teams having the fewest man days lost due to injuries over the three month period. Rules of the contest were drawn up, a committee appointed to arbitrate points of dispute and the first contest was started Oct. 1, 1930.

The first contest was ended with a cost of accidents of 2.9c per ton, making a savings of $6789.14 Half of this amount, or $3394.57, was distributed to 127 men and 5 foremen. The foremen received 15% of the total which amounted to $100.00 each, and the men $22.78 each.

To date seven contests have been conducted, each for a three month period. The success of the first contest has not been obtained in every succeeding period but the results as a whole are very gratifying. Rules have been changed and new ones made, but the general plan has been followed in every contest. One of the main changes that has been made has been to make the rules more strict on time lost and now calculations are made on a basis of man hours instead of man days. When the contests started it was figured the winning team would be the team with the fewest man days lost and a second, third and fourth team could be picked according to the number of man days lost and awards made on that basis. It is however, a matter of record that no team has shared in any of the money in any of the seven contests which has had any lost time charged against it. There have been as many as ten teams to go through the three month period without any compensable injury or any lost time due to injuries. As many as 365 men have shared in one contest. This alone shows the success of the plan.

After the sixth contest the mine was shut down for about 4½ months and when work was resumed the contests were not started and during this period from August, 1932, to December 31, 1933 the cost of accidents was 5½c per ton.

The seventh contest was started January 1, 1934, and for the three months from January 1 to April 1 of this year the cost of accidents was .024c, leaving $6,271.94 saved. Half of this, or $3,135.97, was divided among the men and foremen. From the point of cost of injuries this contest just ended was the most successful and the management is still sold on the principle of paying the men to take care of themselves and their fellow workmen.

Here are the results of each contest:

Contest	Date	Number of Foremen	Amount to Each Foreman	Number of Men	Amount to Each Man	Total	Tonnage	Cost of Accidents
1st	Oct. 1 to Dec. 31, 1930	5	$100.00	127	$22.78	$3,394.57	324,011	$.029
2nd	Jan. 1 to Mar. 31, 1931	5	105.73	118	23.99	3,524.77	325,357	.028
3rd	Apr. 1 to June 31, 1931	4	25.00	137	5.00	785.00	255,303	.044
4th	July 1 to Sept. 31, 1931	6	25.00	253	4.70	1,340.58	269,625	.040
5th	Oct. 1 to Dec. 31, 1931	8	5.00	357	1.47	415.50	201,278	.046
6th	Jan. 1 to Mar. 31, 1932	10	10.00	318	2.91	1,027.58	145,103	.036
	Idle March 31 to Aug. 11, 1932							
No Contest from Aug. 11, 1932, to Dec. 31, 1933, accidents cost .055c per ton								
7th	Jan. 1 to Apr. 1, 1934	8	58.80	288	9.26	3,135.97	246,727	.024

Total amount distributed to men and foremen during 21 months of operation of the seven contests, $13,623.97.

C. F. Hamilton: You have all heard the papers, and I think we should have some discussion on them. Will ask Mr. Martin to say a few words.

Enoch Martin: It is not my desire to take part in the discussion, for the reason I have just joined this Association, and I would rather just listen.

C. W. McReaken: As a matter of information, I would like to ask Mr. Leming how he figures his partial and total disability cases on a three months period?

Ed Leming: We have our doctors make an estimate on those injuries and try to make it high enough to take care of everything and so far our estimates have always come out very well.

Our tonnage has increased right along since we started this, and you would be surprised at the interest an employee of one team shows in the safety of another employee of his own team.

At first we figured the foreman should get 15% of the saving, but at his time we are thinking of cutting he foreman's part down to 10%.

All of our men have had some first id training and about 75% of them ave finished the course.

John Millhouse: When I came on his boat trip I thought I would just isten. But when you start talking bout safety in mines and accident revention, I find it too hard just to isten.

I believe that everyone here is very nuch interested in preventing acci-lents. I believe one of the primary nterests of our Institute is to aid in he prevention of accidents. But we re not getting the results we ought o. And my observation and exper-ence has taught me this: that unless ou can sell the operators on acci-lent prevention you will not get very ar. Some of our companies have aken this thought in mind and fol-owed it out, both as a humanitarian nd as a business proposition.

However, I believe there is one ngle to this proposition that we are ll forgetting, and that is the attitude oward life of the worker. There is desire in the heart of every man o feel secure. And if the workers vere guaranteed economic security I m sure our accidents would be naterially reduced. For a man who s deprived of his work to such an xtent that he can not adequately rovide for himself and family soon loses interest in life, even to the point of leaving this world before he ought to.

You heard a very interesting discussion by Mr. Leming, which gives some of his experience in accident prevention, and shows you are going to have to pay men to keep themselves safe. Paying men to work safely is something new. Why should a man be paid for taking care of his life and limb? But somehow you must do this. But a man should have something to look forward to in the future. Many men in our mining industry today have raised large families, and their attitude toward life cannot tend to help the cause of safety under stressed economic conditions. You men have probably read the answer to this made by our great President. He struck at the root of all things—"Security." What security have you got? I may be wrong, but I hope I am not. I believe if the mine operators and men would think more of this than wages and bargaining, the whole industry would be better off.

C. F. Hamilton: Between the State and National government it seems that we have had an open season on making laws or changing laws. Very appropriately your Program Committee has had a paper prepared upon the history of law making in relation to explosion hazards, by Mr. John E. Jones.

CAUSES AND PREVENTION OF MINE EXPLOSIONS — A REVIEW

By JOHN E. JONES
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This address was given before the Mine Inspectors Institute of America, Pittsburgh, Penn., May, 1933, and the Illinois Mining Institute Boat Trip June, 1934.

Experience is a stern and relentless teacher. She does not quibble concerning the answers to her problems. Her students profit when their answers are correct. Fortunately, we can to a great extent copy the lessons and answers from one another. She is more stern, more cruel, in some of her subjects than in others, there being less margin of safety between correct and incorrect answers. Among such of her subjects is that of mine explosions. She has manifested no patience, applying the same punishments decade after decade for the lessons not learned, or not applied.

This following brief but general review of causes and prevention rightfully begins with the first recorded events. It deals with the causes as given and the slow evolution of preventive measures. We have now had more than three centuries of experience and the lessons have been fairly well learned. Their application commensurate with the rapid growth of a century of industry in our nation has not been so thorough.

America's knowledge in coal mining, when the industry began, had a background of two centuries of European experience. The earliest recorded hazards show these to be chiefly water and choke-damp, the fire-damp hazard being encountered with more extensive and deeper penetration for coal.

The first record in Great Britain of accident occasioned by fire-damp is found in the registry of St. Mary's Church, Gateshead, under the date of 14th of October, 1621, where is recorded the interment of "Richard Backas burn'd in a pit." This is found with other records pertaining to pit accidents. The same author quotes in part from The Compleat Collier of 1681, " . . . . by his ignorance he may be burnt to death by the surfet (fire-damp), which is another dangerous sort of bad air, but of a firey nature like lightning, which blasts and tears all before it, if it takes hold of the candle, while an experienced laborer will discover and extinguish though it be going to take at his candle, and can sometimes smell to be dangerous or hurtful; therefore all sinkers should be skilled in these matters for their own security sake, as also for the benefit of

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NOTE—Much of the material in this paper has been taken from:
"Annals of Coal Mining and the Coal Trade," Galloway.
"Historical Review of Coal Mining," Mining Association of Great Britain.
The Colliery Year Book of Great Britain.
U. S. Bureau of Mines Annual Fatality Bulletins.
"History of the Coal Mines of the United States," Roy.
Bureau of Labor Statistics of Illinois.
History of the Explosives Industry in America.

the master of the colliery. For if 1,000 pounds, or more, be spent in carrying down a pit or shaft, almost to the coal expected, and then by an ignorant man should be blasted by a strong blast, by surfet, so that it may (as has been known) tear up your timber work and shatter the gins, and take the stone work and frame work, so as to let in feeders of water, besides the destruction of the persons in the shaft, this would be a dismal accident with a witness." The foregoing is the first recorded cause and proposed prevention the writer has found.

In Derbyshire, as in a number of other parts of the kingdom, explosions of fire-damp began to become alarmingly violent about 1665-70. An account of various kinds of damps with which mines are infested, with remarks regarding them, from the pen of Mr. Jessop, of Broomhall, Yorkshire, was communicated to the Royal Society, in two parts and published in the Philosophical Transactions. After writing upon three damps, he continues "The fourth which they call a damp, is that vapor, which being touched by their candle presently takes fire, and giving a crack like a gun produceth the like effects, or rather those of ligthning." It is from Mr. Jellop's writings that we learn, " . . . fire was known to be a present remedy, if by means of it a circulation of air could be produced through the infected place." Evidently stoppings were used prior to this time.

As it became necessary to work deeper seams, and as ventilation from the "fire lamp" developed, the collieries increased in size and more work people employed thus exposing more lives at a time to the risk of accident. Fire had been employed prior to this time to ventilate coal mines in Belgium. Dr. Plot in writing about the removal of choke-damp wrote in 1675, " . . . but chiefly by fire, which they let down in an iron cradle they called their lamp."

An early report given by Mr. J. Beaumont to the Royal Society in 1681 upon explosion prevention is, "Many men of late years have been killed, many others maimed and burnt; some have been blown up at the work's mouth." To combat the fire-damp the miners endeavored to "keep their air very quick" and made use of very thin candles.

In the removal of gas an early method was "beating out the gas" as with a coat. This was used very early to remove choke-damp. However, it was a secondary method to that termed the "ordinary" way. This method of gas removal was by firing. There are many records of its use but the earliest account of this primitive system is in a paper prepared in 1675 for the Royal Society by Mr. Roger Mostyn. A new shaft was sunk and as the coal excavation progressed and there was scarcity of air the fire-damp began to "breed." At first the workmen toyed with it with their lighted candles, until one morning "the first collier that went down, going forward in the witchet with his candle in his hand, the damp presently darted out violently at his candle that it struck the man clear down, singed all his hair and clothes, and disabled him from work hereafter." The colliers then would select one from their group, more resolute than the rest, to go down and ignite the gas. Clothing himself with the worst rags he had, saturated with water, this "fireman" crawled forward holding a long pole before him with one or more lighted candles at its end. Should flame result the fireman would lie flat on the floor.

Upon completing his rounds the other workmen would enter. In one mine, at least, the gas was fired three times per day.

Reference has been made to the fact of the first accident on record occasioned by fire-damp having taken place in a pit at Gateshead in the early part of the Seventeenth Century. Here also it was that the first great colliery explosion, involving the loss of a considerable number of lives, occurred nearly a century later. This happened about the 3rd or 4th of October, 1705, over thirty individuals perishing by the blast. From the burial record of St. Mary's Church, Gateshead, is found the list of the dead under the dates (evidently) that the bodies were recovered. The list is headed by the remark, "These were slain in a coal pitt in the Stony Flatt, which did fire."

Three years later, 18th of August, 1708, at Hatfield there occurred the sudden eruption of violent fire discharging itself at the mouth of three pits, with as great a noise as the firing of cannon, or the loudest claps of thunder, and sixty-nine persons were instantly destroyed. Three of them, viz., two men and a woman, were blown quite from the bottom of the shaft, 342 feet deep into the air, and carried to a considerable distance from the mouth of the pit. After explaining the effects of stith (choke-damp) and sulphur (fire-damp) the narrator proceeds to say:

"To prevent both these inconveniences, as the only remedy known here, the viewer of the works takes the best care he can to preserve a free current of air through all the works, and as the air goes down one pit it should ascend another. But it happened in this colliery, there was a pit which stood in an eddy, where the air had not always a free passage, and which in hot and sultry weather was very much subject to sulphur; and it being then the middle of August, and some danger apprehended from the closeness and heat of the season, the men were with the greatest care and caution withdrawn from their work in that pit and turned into another; but an overman, some days after this change, and upon some notion of his own, being induced, as is supposed, by a fresh, cool, frosty breeze of wind, which blew that unlucky morning, and which always clears the works of all sulphur, had gone too near this pit, and had met the sulphur just as it was purging and dispersing itself, upon which the sulphur immediately took fire by his candle, which proved the destruction of himself and so many men, and caused the greatest fire ever known in these parts."

From the above account it is obvious that the Hatfield pits were at this date (1708) still dependent upon such circulation of air as could be obtained from natural ventilation.

As the coal industry developed in the early part of the 18th Century explosions became more frequent and more terrific. Fire setting, fire lamp and candles were the chief causes of ignition. More attention was given to ventilation and in about 1765 the improved method from Cumberland of "coursing the air" was begun in the north of England. Hitherto it had been deemed sufficient to cause the ventilating current merely to sweep round the points where the miners were at work getting coal—an arrangement known as "face airing" to the neglect of the waste. The too frequent explosions forced the adoption of the practice to ventilate the entire mine. Wallis, writing in 1769, remarks that "against this vapour, or damp, a large iron lamp full of coal is kept continually burning in the mine." A century earlier, at Liege, a chimney or tube above one of the openings was known. At the early part of the 18th Century in England the ventilating fire was sometimes placed at the surface in connection with the tube. The steam ventilator, the hot cylinder and the air pump were tried in fiery mines at about this period. Considerable light was shed on the principles of ventilation by M. Jars who appears to be one of the first to make a scientific inquiry into the phenomena connected therewith and who left an account of the results of his investigations in a memoir written in 1764. He had frequently inquired why it was customary to build tall chimneys on the surface to promote a circulation of air in mines but failing to obtain a satisfactory explanation, set about examining into the matter himself, arriving at the conclusions now so well understood by mining students. The great discovery of the pressure of the atmosphere had been applied by men of science prior to 1662.

It is natural that the illumination in coal mines would, at first, be similar to that used in dwellings. Examples of lamps in bronze and terracotta have been left by the Romans. In England, candles replaced the lamps. A knowledge of fire-damp naturally led to attempts at safer illumination than by open lights. Workings very close to the surface were in a limited way illuminated by reflecting mirrors. Attempts also were made to use the light from phosphorescent materials, such as fungus tinder, or partly putrescent fish. The use of the latter was chiefly in rescue work.

The steel mill was introduced in this early period. They were first used at Hatfield Colliery on the Wear, after an explosion which occurred in 1763; having been brought from Whitehaven, where they had been invented shortly before by the ingenious Mr. Spedding. The first reference to it is in 1753. In this machine a thin disc of steel, five or six inches in diameter, was made to rotate (by handle and gears) with great velocity against a piece of flint. A continuous flow of brilliant sparks was emitted which afforded a glimmery light for five or six miners. It was at first regarded as being safe but was soon found not to be absolutely so. The sparks gave indications of the presence of inflammable gas by increase in size and luminosity. On approaching the firing point they gave off a bluish light, and when in excess of the explosive limit the sparks were of a blood red color.

We thus find in the infancy of coal mining the very causes, viz., accumulation or sudden liberation of fire-damp, atmospheric changes, open lights and sparks, which we have today and also two of the fundamental preventions, attempts at ventilation and safe illumination.

From the end of this 200 year period of infancy, 1800, for the next 125 years is a period of growth in coal mining that is one of the greatest factors, if not the greatest towards our present industrial development. Virtually it set the wheels of industrial progress turning. More scientific and political thought has been given to prevent explosions than any other mining hazard. Many improvements resulted because of professional men, unconnected with the industry, taking interest. The 19th Century begins with the soundest suggestion that was offered at this time (1805) by an anonymous writer who styled himself "A friend to rational schemes of improvement." He was the inventor of "splitting the air." This was probably Mr. Buddle, the greatest mining magnate of that time.

Greatly improved ventilation conditions were now possible with this new method. By 1850 furnace ventilation was improved to give larger air volumes and the hazard of explosive gases passing over furnace fires was reduced. Volume of air passing per minute in at least one mine was increased from 5,000 cu. ft. per minute in 1835 to 121,360 cu. ft. per minute in 1850. At one colliery in 1850 the volume amounted to 190,000 cu. ft. per minute induced by three underground furnaces. Another colliery records 96,300 cu. ft. per minute in 1835. But explosions also increased. Galloway states that during the period 1835-50 no less than 643 explosions took place in the coal mines of Great Britain (an average of over 40 a year) and that the following facts were definitely established:

(1) That as a rule explosions were of most frequent occurrence in the early part of the week.

(2) That they were caused for the most part by accumulation of fire-damp taking place during periods of cessation of work, when the ventilation of the mines was in a more or less stagnant condition.

(3) That the ignition of the fire-damp was brought about in the majority of cases by the persistent use of naked lights in fiery mines.

In this same period mechanical ventilators had their inception; 1807—exhaust air pump at Hebbum Colliery; 1827—horizontal fan at colliery in Scotland; 1849—Brunton fan at Gelly Gaer Colliery, Glamorganshire. The Brunton fan is the first centrifugal fan. By 1850 furnace ventilators had almost entirely been replaced by mechanical ventilators on the continent. In Great Britain, however, furnace ventilation up to this time was considered the more reliable. Mr. Guibal's (of Belgium) invention of the spiral casing, shutter and evase chimney at about the same time made possible the use of the centrifugal fan, from that time to the present the standard ventilating unit.

It was during the first half of the 19th century that safe lighting of mines was given much important consideration. An explosion in 1812 at the Felling Colliery in which 92 miners were killed was an important stimulus. From 1813 to 1816 was a three year period in which the Clanny, Stevenson and Davy lamps were invented. The controversy is well known to all mining students. None of these lamps were patented. The reason is contained in Sir Humphrey Davy's reply to a query upon this question—"No, my good friend. I never thought of such a thing; my sole object was to serve the cause of humanity, and, if I have succeeded, I am amply rewarded in the gratifying reflection of having done so."

There evidently was opposition to the safety lamps as is shown in the following two extracts. In one the pitmen of the Tyne and Wear published in a pamphlet in 1825 the following statement: "Sir Humphrey Davy's invention of the safety lamp has been an advantage to the coal owners, but a great injury to the comforts and earnings of the pitmen, for while the former remain indifferent about the safety of the mine, and neglect to force the atmospheric air to the inner part of the pit, on account of the great power of the safety lamps to resist combustion or explosion, the poor miner has to sufer the most awful agony in an exeedingly high temperature, inimical o the health, comfort and even life." n the other is an extract from a reat Britain—Select Committee on ccidents in Coal Mines—which in 835 expressed the opinion on the nerits of the Davy Safety Lamp 'that ignorance and a false reliance n cases attended with unwarrantable isk, have led to disastrous conseuences." The committee, however, ecommended a more extended use of afety lamps.

Legislation for mine safety was low to start. This was largely due o the miners of that early age having leveloped into a race isolated from he rest of the people. They develped into an inferior people, such gnorance prevailing as to present no hought or hope for assistance from ociety. The explosions and terrific oss of life, however, had attracted utside attention and in 1813 there vas formed the Sunderland Society. ir Ralph Millbank was president of he Society. This organization ecured the services of Sir Humphrey avy. So momentous was the disovery of his safety lamp considered, he Sunderland Society dissolved itself n the ground the object of its fornation had been achieved. A similar xpression was given in January, 816, by Mr. Buddle, one of the comnittee to test the Davy lamp, in the tatement, "To my astonishment and lelight, it is impossible for me to xpress my feelings at the time when first suspended the lamp in the nine, and saw it red hot; if it had een a monster destroyed, I could ot have felt more exulted than I id. I said to those around me, 'We ave at last subdued the monster.' "

The series of accidents in 1837 and 838 caused interest again to be aoused from the outside. In consequence of an explosion at the Hilda Colliery at South Shields in 1838 in which 51 miners were killed, the South Shields Committee formed and set themselves to investigate coal mine hazards. Mr. Thomas Mather was president of this committee. Their report, containing the results of three years' work, was indeed thorough. It dwelt strongly upon registration of plans, inspection, and prohibition of women and child labor. Part of this became a law in 1842.

In 1845, again in consequence of a series of accidents, two commissioners were appointed, this time by the government, to inquire into the dangers from noxious gases in the mines and to advise on the means of preventing the evils caused thereby. The movement was fostered by Lord Ashley. Their report, promptly embodied in a bill to the House of Commons contained an elaborate inspectional system resembling that which exists today. But the time was not yet ripe and the bill was dropped, as was another proposed for the prohibition of naked lights and gunpowder in fiery mines. Sir George Elliot, once a trapper boy, but then one of the leading colliery operators, testified and among other things said, "I am a great advocate for plenty of air in a pit; I believe it is the cheapest way to work a mine safely; I believe in government inspection of mines; the inspectors ought to go down the pit, and they ought to be practical men who understand the pit when they go down; in fact, they ought to be practical miners."

Interest in legislative action was increased by the Haswell disaster which in 1844 caused the death of 95 persons. This colliery was regarded as a model colliery. Ignition was from a candle or a faulty safety lamp. Professor Faraday, Sir Charles

Lyell and Mr. Scutchbury were appointed by the government to report upon the cause. The burden of this work fell upon Faraday. In their report they stated that:

"In considering the extent of the fire from the moment of explosion, it is not to be supposed that firedamp is its only fuel; the coal dust swept by the rush of wind and flame from the floor, roof and walls of the works would instantly take fire and burn, if there were oxygen enough in the air present to support its combustion, and we found the dust adhering to the face of the pillars, props and walls in the direction of, and on the side towards, the explosion, increasing gradually to a certain distance, as we neared the place of ignition. This deposit was in some parts half an inch, and in others almost an inch, thick; it adhered together in a friable coked state; when examined with the glass, it presented the fused, round form of burnt coal dust, and when examined chemically, and compared with the coal itself reduced to powder, was found deprived of the greater portion of the bitumen, and in some instances entirely destitute of it. There is every reason to believe that much coal-gas was made from this dust in the very air itself of the mine by the flame of the firedamp, which raised and swept it along; and much of the carbon of this dust remained unburnt only for want of air."

From these various commissions and their reports, and the pressure of public opinion, the government at last was induced to present a bill of its own which passed on August 14th, 1850, with provision for four inspectors, and that the bill should only continue in force for five years. The trade unions now began to press for legislation to make definite safety measures compulsory. A leader was Alexander McDonald from Scotland. On August 14th, 1855, a law replaced the previous one and for the first time laid down a standard set of seven rules to be observed by all mines. This law also was to continue in force for five years. The bill introduced by the government on February 14, 1860, was designed to be a permanent document. This new act was supplemented two years later by another requiring the provision of two shafts at every mine, this new act being the result of the imprisonment and suffocation of 205 miners on January 16, 1862, in the Hartley Colliery, caused by the breaking of the pumping beam of the water engine. One half of it, weighing 20 tons, fell down the shaft filling up the only exit with debris to a height of 60 feet from the bottom.

These two acts mark a definite epoch in the history of mining legislation. The law had been brought to very nearly apply to the mining science of that period. While considerable reforms were agitated, no further bills were passed until 1872 when a bill was passed which was destined to codify and stabilize the mining law for a period of fifteen years. This law embodied practically all of the principles which now direct the administration of the law so far as safety is concerned. Subsequent legislative acts, while relatively voluminous, have been based upon the application of the principles laid down in the mining law of 1872.

Along with the natural explosion hazards there had been introduced at a very early age the hazard of gunpowder. It had been used prior to 1627 in Hungary and Germany for blasting minerals and was introduced in the Cornish mines in 1689. The first mention of its use in the coal nines is in 1719 when it is spoken of as dealing with a hard rock. It had ecome the common blasting agent n the early part of the 19th Century. n 1831 William Bickford invented is safety fuse which marked a great dvance on the earlier crude methods f firing charges of powder. Electric etonation had been considered arlier but was not of practical use se until about 1840. Dynamite was iscovered by Nobel in 1867. In 875 he invented the gelatinous exlosives which were the forerunners f present day permissibles.

As the use of blasting explosives n mining extended, the occurrence of everal serious disasters caused the overnments of most European ountries to study the cause of these ccidents. In Great Britain, attenion had been paid from 1835 and uch attention led, in 1872, to the Coal Mines Regulation Act of that ountry. Special "Fire Damp" comnissions in France (1877), England (1879) and Germany (1880) gave onsideration to explosions originatng from blasting. Early attempts o control blasting flame from ignitng gas and coal dust included the lacing of a water cartridge above he charge, moist non-combustible amping, and a water curtain in front f the bore hole. These methods id not solve the problem and efforts vere made to devise explosives that vould be safe. In Great Britain a ommittee was appointed in 1888 to nake inquiries into and report on the ubject of "flameless" explosives. Much progress resulted from about 897 in "permitted" explosives for oal mine use.

There is some doubt as to when lectricty was first introduced into ollieries. This in Great Britain was robably in Trafalgar Colliery (Forst of Dean) where a small pumping set was installed below ground in 1882, and an arc lighting set at the pit top in the same year. The development and use of electrical appliances underground in Great Britain has been under strict supervision and regulations so that, compared with the United States, electric installation for underground work is small. However, mine lighting of pit bottoms and other such permanent locations has become general. The first satisfactory attempt of underground lighting was in 1882 in Scotland.

Portable electric lamps were being supplied in 1889 by John Davis & Son but the development and use in Great Britain has been relatively slow.

As previously stated, Faraday in 1844 had drawn attention to the effects of coal dust in extending the flame of an explosion, but the first investigator to realize the real part played by coal dust in producing explosions was Dr. William Galloway of Cardiff. As a Junior Inspector of Mines, he had opportunities to see the effects of several great explosions in Welsh collieries, and he drew the conclusion that it is coal dust which carries the flame with such disastrous effects along the roads of a colliery.

His conclusion was so unpopular that he was obliged to resign his appointment as Inspector. Messrs. W. H. and J. B. Atkinson then published a book, also very unpopular at the time, supporting Galloway's views. By degrees, the new views made headway and received the support of a Royal Commission, which reported in 1893 after various very convincing experiments had been made for it. As study was made of "safety" explosives, the problem of rendering the coal dust inexplosive was further considered. Watering was partly carried out or attempted in many collieries. Dr. Galloway, Mr. Atkinson and Mr. Garforth had observed that a coal dust explosion was checked wherever a considerable percentage of stone dust was present on a colliery road. Experiments were conducted by Mr. Garforth at Altofts Colliery, which was under his management. Here much of the present knowledge relative to the possible effectiveness of stone dust was learned. The possible dangers of damage and injury resulted in moving the gallery and apparatus to a site near Eskmeals, on the Cumberland Coast away from ordinary human habitation. Coal-dust explosion tests by France at Lievin under Taffanel were begun in 1907 after the Courrieres disaster (1100 deaths), and by Great Britain in 1908. The British Coal Commission on Coal Dust sat from 1891 to 1894.

Success in the prevention of explosions in Great Britain did not obtain at once upon the discovery of the means of prevention. Explosions persisted but at a declining rate. As stated, explosions in the early part of the 19th Century were at the rate of 40 per year. It seemed that with each of the early discoveries, explosions increased in number and in violence. Great advancement, however, has been made in the last half century as is shown by the accompanying graphs.

This address to this point has been a brief review of the causes of explosions chiefly in Great Britain, and is a review of the efforts at prevention. The experience and its resultant legislation in that country is equally the heritage of the United States. The beginning of coal mining here was a duplication of the experience in the old country, men from the pits there migrating here to develop and work the coal mines of America for their livelihood.

The early 18th Century experience here in working the coal close to the surface, having water and chokedamp as the chief hazards, was similar to the experience in Great Britain of the late 16th Century. The greater area and relative shallowness of coal measures here presented and still present a less acute problem in fiery mines as compared with the old country. However, coal production here increased at a much greater rate, the development of mines and the consequent legislation covering a much shorter period of time.

The birthplace of the coal industry in America rightfully belongs to the Appalachian coal field. In 1786, twenty years after Pittsburgh was laid out, William Penn was granted a charter to mine coal in the hills fronting the city. Coal was first mined along the Monongahela River. The first mining company formed was in the anthracite field. It was the Lehigh Coal Mine Company organized in 1803.

The first explosion disaster, causing five deaths or more, recorded by the Bureau of Mines, is one near Richmond, Virginia, in 1839. It caused the death of forty men. The next is at Pottsville, Pennsylvania in 1847 losing seven lives. From 1850 to 1867, six explosion disasters caused the loss of 176 lives, all in Virginia. The Avondale disaster was the result of a mine fire, the furnace igniting the shaft partition. It occurred on September 6, 1869, and 179 (Roy gives 109) lost their lives through suffocation. This was almost a duplicate disaster to that of the Hartley Colliery in England in 1862 both of which were instrumental in laws being passed for two places of egress.

The leading coal mining states quickly adopted mining laws, using the British law to guide them. Among the first records is an appeal, in 1858, of the miners of Schuylkill County, Pennsylvania, to the State Legislature because of the very high fatality rate. It was not considered, and in 1866 the bill was again introduced but was defeated in the Senate. In 1869 it was successful. It provided for one inspector for Schuylkill County, the other counties being left out. The next year following the Avondale disaster of September 6, 1869, a law was enacted for the anthracite field. There was no effort to have its provisions include the bituminous field, the soft coal miners of Pennsylvania making no legislative effort until 1876 when a commission was appointed by the Legislature and the first mining law was enacted on the 19th of April, 1877, providing for the regulation, ventilation and inspection of the bituminous mines of that State.

Illinois is the first state in the union to recognize by legislation the need for laws in the bituminous coal ndustry. Many efforts were made prior to 1870 in that direction but hese had proved ineffectual. When he Constitutional Convention of 1870 was organized, however, one of he first committees formed was on "Mines and Minings." One of the first reports presented for the conideration of that body of men, was prepared by the committee. A very full discussion of its merits took place on the 24th of January, 1870, and resulted in incorporating into the onstitution the following language of article four of section twenty-nine:

"It shall be the duty of the General Assembly to pass such laws as may be necessary for the protection of operative miners, by providing for ventilation, when the same may be required, and the construction of escapement shafts, or such other appliances as may secure safety in all coal mines, and to provide for the enforcement of said laws by such penalties and punishments as may be deemed proper."

With this section as a basis, many legislative acts on coal mining were made during the decade 1870-80. The first Illinois mining laws enacted under the provisions of the Constitution was by the 27th General Assembly (1871), approved March 27, 1872. It provided for inspection of mines by county inspectors and all reports to be made to county boards for the health and safety of persons employed in coal mines. The following session a change was made making the County Surveyor ex-officio inspector of mines. This was unsatisfactory and on May 23, 1877, the Act of 1872 was amended by creating office of mine inspector in each county where mining was carried on, giving the County Board the right to appoint inspectors in their respective counties. Great dissatisfaction existed in regard to inadequacy of the laws and to the county inspection service because of its inefficiency so that on June 18, 1883, the 33rd General Assembly passed a complete revision of the mining laws of the state, including a state mine inspection system. The other leading coal mining states had preceded Illinois in the adoption of this system of inspection. The county inspection system, however, was not abolished, the resultant mining law authorizing state mine inspectors to require county boards to employ county mine inspectors. Nearly all coal producing counties employ county inspectors as assistants to the state mine inspectors.

Ohio was the second state in the union to receive legislative recognition in the bituminous fields, 1873; Maryland was third, 1876; and Pennsylvania was fourth, 1877. The other states soon followed until now all of the coal mining states have laws fairly commensurate to the mining science of today in the prevention of explosions.

As in the earliest years of coal mining in the old country, explosions here increased at an alarming rate for many decades. One would expect, having a less gassy condition and the experiences of the old country, that the explosion rate here would be less than in Great Britain. The two graphs on print No. 1 show that explosion fatalities per 100,000 men employed and per 1,000,000 tons of coal produced are less in that country.

Coal mines in the United States were at first almost wholly manned by emigrants from coal producing countries. These men brought over with them both their experience and desire for greater independence. They left a strict supervisory system of mining approaching militaristic regulations, to work in a loosely regulated system in which discipline as known in the old country did not exist. There were also many employed in the mines here as miners, but who had never worked in mines. The growing youth became full-fledged mine workers without the training in safety procedure and apprenticeship regarded essential over the sea. Tales at the fireside, at times exaggerated, tended to impress the young that the discipline their fathers lived under was oppression. Need for individual care against explosions was apparently of but little importance and therefore was not stressed. Legislation seemed to be the hope to prevent explosions, but even as legislation became enacted, ventilation improved, and inspection increased, there was an alarming increase in number of explosions and number of explosion fatalities.

During the three decades from 1880 to 1910, an excessive number of explosions from the handling and use of black powder added to the explosions originating from fire-damp. States, such as Iowa, having practically no gas hazard, began to have explosion disasters. In some sections coal mining resembled quarrying. The quantity of black powder used for one blast would occasionally be the entire contents of one 25 pound keg and frequently one keg to break down sufficient coal for one man for one day. An illustration of the increased use of black powder is that in the 5 year period 1882-6, (no mining machines reported) 74 tons of coal per keg of powder were produced in Illinois, while in 1902-6, (an average per year of 672 mining machines were reported) only 41 tons per keg were produced.

There are many who can recall the controversies on stopping the fan at shooting time, and the discussions on the explosiveness of coal dust during this period. The 1888 coal report of Illinois refers to coal dust as being the "new danger in coal mines," although the first recorded explosion disaster of the State, January 9, 1883, in Coulterville, had been known as being initiated by a black powder shot and propagated by coal dust.

America was slow in taking up the study and application of "Safety Explosives," and up to 1902 very little was done. At this time, the DuPonts sent a man to Europe to study what had been done there since the appointment of their "Fire Damp" commissions. This resulted in the installation (1904) of testing equipment in the Company's laboratory and later (1907) the Technologic Branch of the U. S. Geological Survey to study mine explosions and explosives. The Pittsburgh Testing Station was opened on December 3, 1908. The Technologic Branch was raised to the status of an independent bureau in the Interior Department by the act of May 16, 1910, which created the U. S. Bureau of Mines "to make diligent investigations of the method of mining, especially in relating to the safety of miners, the use of explosives and the prevention of accidents, and other matters relating to mining." The work done at the experimental mine and the explosives testing laboratory, located at Bruceton, Pennsylvania, is very well known. With the introduction of good permissibles in 1908 there came a rapidly increasing demand for this type of explosives so that by 1924 about 50,000,000 pounds were used annually in the coal industry of the nation. At that time consideration was being given to the loosening of coal by the expansion of the inert and harmless gas, carbon dioxide. This requires a steel cartridge. It is a permissible device and is used in some of the gassy mines in this nation and in Europe. A new device being introduced at this time (1933) is one that uses carbon dioxide and compressed air, and another using only compressed air.

As prevention against blasting succeeded, a new hazard in the ignition of gas developed. The machine age in coal mining is considered as having begun with the mining machine. The compressed air puncher was introduced in the early 80's but its life was short after the introduction in the early 90's of the electric chain mining machine. The electric locomotive was introduced at about the same time, and since then the growth in the use of electric energy in coal mines throughout the nation has been phenominal. From 1910 to 1923 the number of electric locomotives increased from 5000 to 20,000. Mechanization in mines of the United States is generally understood as electrically driven machinery.

Explosion disaster fatalities from ignition of electric arcs or sparks have increased. In 1931, 154 of the 264 fatalities were from electric ignition, in 1931, 13 of the 56 fatalities, and in 1932, 14 of the 145 fatalities. For the 3 year period, 39% of the explosion disaster fatalities were from electrical ignition origin. The Bureau of Mines grants permissibility to flame-proof electrical machinery. This is the most difficult of the permissible equipment to be kept flame-proof because of the frequent need of repair of the machines and the difficulty in maintenance in accordance with their original permissible standard.

The first miners' electric lamp approvals given by the Bureau of Mines were in April, 1913, at which time three lamps were placed on the permissible list. These were later withdrawn. The first permanent approvals were three lamps in 1915. The original intent was the use of a lamp that would not ignite gas. The success of that original intention is beyond question. There has been added the factors of practicability and greater illumination, and the success of these is also beyond question. The following tabulation is given to show the rapid growth of this safety factor in the United States.

	Safety Flame Lamps	Permissible Electric Lamps
1912 -------		None
1915 -------	140,000	20,000
1920 -------	100,000*	140,000
1925 -------	80,000*	200,000
1930 -------	65,000*	260,000
1933 -------	59,000	285,000

*Estimate.

The Bureau of Mines has experimented extensively upon coal dust explosions and the value of rock dust, in its experimental mine, and has published the findings from time to time. This work was begun in 1911 and has progressed to the present almost without interruption. The first practical application of rock dust in the United States to prevent the propagation of an explosion by coal dust was in 1912 in the Delagua mine, Victor American Fuel Company, Colorado. The second was in the Old Ben Coal Corporation mines in Southern Illinois. This second was the result of a terrific explosion of coal dust, initiated by gas ignited by open light, in Old Ben No. 11 Mine near Christopher. This explosion was on Thanksgiving night (November 29, 1917) and caused instant death to the 17 men who were in the mine. 600 men were employed on the day shift. Flames shot several times far above the surface of both shafts from the workings 600 feet below. The explosion extended into every portion of the workings, except that it was stopped in two rock cuts that had been driven through a "roll." With the assistance of the Bureau of Mines, the coal dust explosion hazard of all the Company's mines was determined and all the Old Ben mines were rock dusted during the next few months. The Coal Company developed barriers and troughs to suit the conditions encountered, and developed an electrically driven rock dusting machine to coat the roof, ribs and floor. This latter method proved to be the most efficient and became the standard method of application. The Company patented the three methods and gave them to the government so that all who may desire may use them.

The Company's success in preventing propagation of explosions by means of rock dust became widely known and mining men from all the chief coal mining states and nations visited the Company's mines between the years 1917 and 1924. This period is accepted as that during which rock dusting "was sold" to our industry. Rock dusting is now done, either in whole or in part, in many of this country's mines that are recognized as having the hazard of explosion from coal dust.

There have been other agencies developed resulting from explosions and the efforts made towards their prevention. Mine safety appliances companies, having among their equipment that pertaining to explosion prevention, are important factors. The personnel of these companies have not only been of great influence in the study of explosion causes and efforts towards their prevention, but also in keeping the coal-mining mind explosion conscious.

Various methods, based upon humanitarian, educational and economic motives, chief of which are our mining schools, the U. S. Bureau of Mines, our state mining departments, mining periodicals, our mining institutes, numerous coal producing companies and compensation acts have and are giving this subject much attention. The thought and work done by these various agencies is good in quality and large in quantity. The only factor of weakness is the nall percentage reaching and being ccepted by those at work in the ines.

My address to this point has been f a chronological nature, simply be- g a review concerning mine explo- on causes and prevention from the arliest records to the present time. abulated data upon causes of igni- on are obtainable from state and ederal annual reports. I wish now include statistical data for as much f the period of this address as I have ecords. This data is shown in the llowing four tabulations and graph- ally in the four plates made from em.

More scientific thought and legis- tive effort has been given towards e prevention of coal mine explo- ns than to all other coal mining zards put together. There has not en, however, an accomplishment of ccess that is warranted by the ef- ts made; that is, the success in eventing explosions is not in pro- tion to the advanced knowledge l laws applicable towards their vention. There is no question but t the pioneers who formulated our ing laws felt that they had done reat work towards the prevention xplosions. It is certain that they cipated greater progress than has n obtained.

he following graphs show that at Britain has in the last half ury made considerable success. is despite the deeper seams ked, therefore more gas and ter difficulty of ventilation de after decade. One of the chief ons for their success in lowering the explosion fatality rates is the strict application of their mining laws. Their tendency of strict compliance with law and order on the surface is observed in the mines and has added to it a sort of militaristic obedience and responsibility. There is also an approach to stabilization of mining methods resulting in one generation of mining men carrying on the work of the preceding generation.

The tendency here in the states is, natural to a younger nation, speed and change. This is evinced upon our highways as well as in our mines. The price of greater freedom is less responsibility.

We now have three centuries of coal mine experience behind us. It is difficult to imagine the quandaries and consternation of the earliest pioneers of our industry who suffered explosion and loss of which they did not know the cause. We of today know the causes of explosions and the means for successful prevention. We cannot plead ignorance of adequate preventive measures in this enlightened day. Success in the future may depend upon the discovery of new preventive methods: in all probability, however, it will hinge rather upon how thoroughly the present known means of prevention are applied.

C. F. Hamilton: I think we should have some interesting discussion on this paper and will call first on Mr. McFadden.

G. C. McFadden: I believe all of you who have been connected with the mining industry are familiar

Table No. 1

TREND OF EXPLOSION DISASTERS AND FATALITIES IN U. S. BITUMINOUS MINES AS RELATED TO MAN-SHIFTS AND TONNAGE

1888-1933

Percentage of Total Occurring Within Each 5 Year Period

Five Year Period	Millions of Tons	Per Cent	Millions of Man-Shifts Worked	Per Cent	Number of Explosions*	Per Cent	Number of Fatalities**	Per Cent
1888-92	540	3.47	208.23	5.04	6	1.95	335	3.76
1893-97	668	4.29	230.83	5.58	15	4.87	319	3.58
1898-02	1,058	6.73	350.17	8.47	26	8.44	833	9.34
1903-07	1,615	10.37	491.20	11.89	52	16.88	1,825	20.47
1908-12	1,986	12.76	572.20	13.85	56	18.18	1,492	16.73
1913-17	2,399	15.41	636.21	15.40	33	10.72	1,322	14.83
1918-22	2,452	15.75	611.86	14.80	29	9.42	454	5.09
1923-27	2,660	17.09	584.04	14.16	49	15.91	1,456	16.33
1928-32	2,192	14.08	447.66	10.83	42	13.64	880	9.87
45 Years	15,570		4,133.41		308		8,916	

*Causing five or more fatalities.
**From explosion causing five or more fatalities.

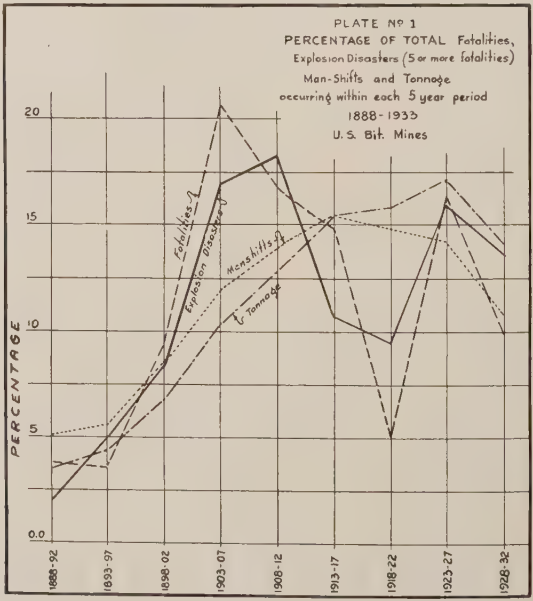


Table No. 2

PLOSION DISASTERS—AVERAGE ANNUAL FATALITY RATE PER MILLION SHORT TONS IN EACH FIVE YEAR PERIOD 1888-1932

	UNITED STATES					GREAT BRITAIN		
	Millions Short Tons Bituminous Mines	NUMBER OF DEATHS IN EACH FIVE YEAR PERIOD		FATALITY RATE PER MILLION TONS		Millions Short Tons* All Mines	Number Deaths in Each Five Year Period	Fatality Rate Per Million Tons, 10 Deaths or More
		5 Deaths or More	10 Deaths or More	5 Deaths or More	10 Deaths or More			
8-1892	540	335	335	0.62	0.62	1,000	532	4.53
3-1897	668	319	286	0.48	0.43	1,025	582	0.57
8-1902	1,058	833	778	0.77	0.73	1,195	116	0.10
3-1907	1,615	1,825	1,709	1.13	1.06	1,345	188	0.14
8-1912	1,986	1,492	1,321	0.75	0.66	1,465	862	0.59
3-1917	2,399	1,322	1,276	0.55	0.53	1,465	464	0.32
8-1922	2,452	454	354	0.19	0.14	1,263	206	0.16
3-1927	2,660	1,456	1,327	0.55	0.50	1,305	279	0.21
7-1931						1,102	122	0.11
7-1932	2,192	880	761	0.40	0.35			

d from Graph.

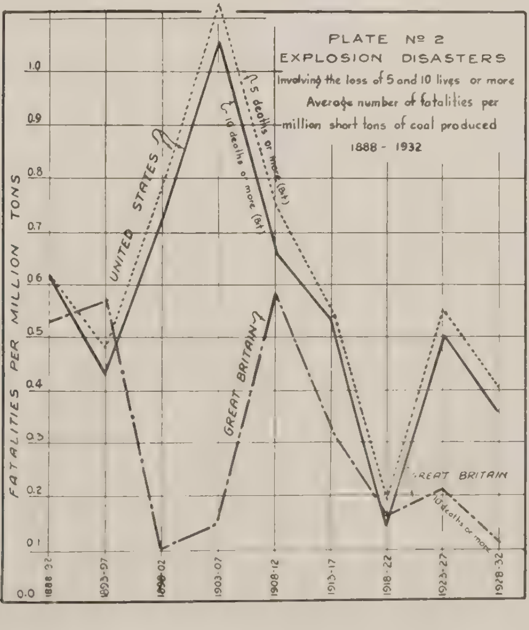


Table No. 3

EXPLOSION DISASTERS INVOLVING THE LOSS OF 10 OR MORE LIVES

Average Number of Fatalities for Each Year of the 5 Year Periods Per 100,000 Employed

1888-1932

	UNITED STATES			GREAT BRITAIN		
	Average Number Employed Per Year (x 1000)	Number Deaths in Each 5 Year Period	Fatality Rate Per 100,000 Employees	Average Number Employed Per Year (x 1000)	Number Deaths in Each 5 Year Period	Fatality Rate Per 100,000 Employees
1888-1892	186	379	40.7	662	532	16.1
1893-1897	241	286	23.7	729	582	16.0
1898-1902	308	778	50.5	803	116	2.9
1903-1907	461	1,709	74.1	904	188	4.2
1908-1912	543	1,271	46.8	1,070	862	16.1
1913-1917	575	1,308	45.5	1,054	464	8.8
1918-1922	646	446	13.8	1,169	206	3.5
1922-1927	620	1,351	43.6	1,154	79	1.4
1928-1931				980*	122	3.1
1928-1932	480	777	32.4			

*Estimate.

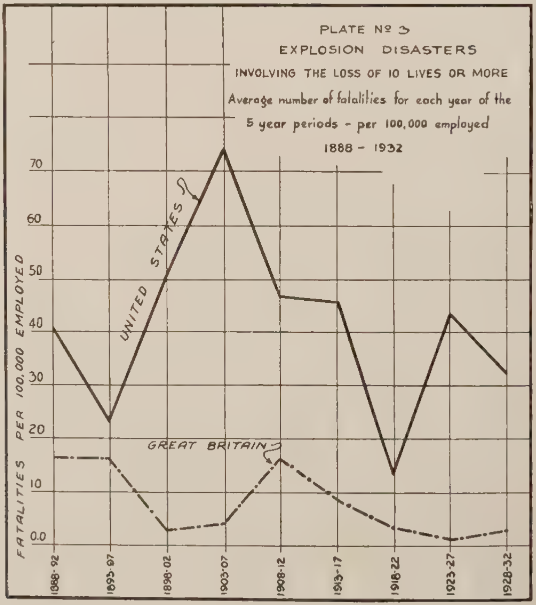
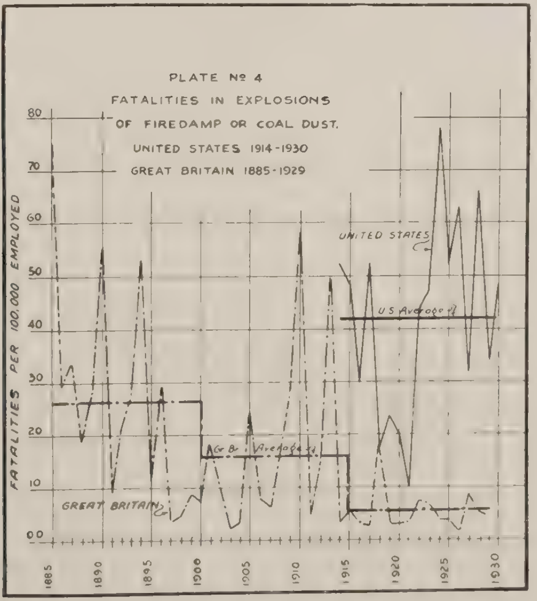


Table No. 4

TALITIES IN EXPLOSIONS OF FIREDAMP OR COAL DUST
NVOLVING ALL EXPLOSIONS RESULTING IN FATALITIES
SHOWING TRENDS IN PERIODS OF FIFTEEN YEARS
UNITED STATES—1914-1930 GREAT BRITAIN—1885-1929

ED STATES		GREAT BRITAIN			GREAT BRITAIN			GREAT BRITAIN		
Fatalities Per 100,000 Employed	15 Year Average	Year	Fatalities Per 100,000 Employed	15 Year Average	Year	Fatalities Per 100,000 Employed	15 Year Average	Year	Fatalities Per 100,000 Employed	15 Year Average
52.2		1885	75.9		1902	9.2		1916	2.7	
48.5		1886	28.8		1903	2.0		1917	2.4	
29.1		1887	33.9		1904	3.1		1918	19.8	
52.9		1888	18.8		1905	25.1		1919	2.8	
16.8		1889	28.2		1906	7.6		1920	2.6	
23.8		1890	54.6		1907	5.7		1921	3.0	
20.0		1891	9.2		1908	15.7		1922	7.8	
9.2	41.59	1892	21.5		1909	27.2	16.56	1923	6.1	
43.3		1893	28.0	25.99	1910	57.9		1924	3.5	5.18
46.8		1894	53.7		1911	4.1		1925	3.2	
78.4		1895	9.4		1912	13.8		1926	1.0	
51.4		1896	30.0		1913	49.9		1927	8.6	
62.8		1897	3.3		1914	3.0		1928	4.7	
31.5		1898	4.6		1915	5.4		1929	4.3	
66.5		1899	8.9					1930		
33.4		1900	7.0							
47.4		1901	18.7							



with the Mining Investigation Commissions that have been appointed for each legislative session to make recommendations for needed changes in our mining laws. Wm. Starks was a member of the first commission appointed.

Our good friend, John E. Jones, and I worked for three years and put in a lot of time to make some constructive changes in the law. But in the final windup we found that all of our work had come to naught, and that our hands were tied, because we could not get even one change that could be agreed on 100%. I would like to have Mr. Starks give you a statement on this.

Wm. Starks: In the matter of correlation of mining laws, you have one factor to contend with, and that is your State Legislature. I don't know how many of you have been in Springfield and seen the State Legislature in session, but I want to say that most of the members in the legislature have very little knowledge of coal mining conditions.

One time I spent three months with a fellow who was a very able man. We met practically everyone in the State of Illinois that ought to know about mines and mining. We had a copy of the mining laws of each and every state, and after all the effort we had put out and changes we had recommended, not one of them was adopted. It is an almost hopeless task, as there are only about five or six men in the legislature who know anything about mining.

I read a paper about three years ago on this boat trip in which I reviewed the mining laws since 1883. In this paper I compared our mining laws to a shed that was built and then a little added on to it every now and then. There is no reason why they should say a cross-cut should be driven about 60 feet. This was all right when the law was made, but we have better ventilation than we ever had before, and we have different conditions now. For instance down in Treadwell's mine at West Frankfort they are using a McKinley machine that cannot drive a cross-cut. But as long as he keeps the air to the face, why should he be put to this extra expense? Gentlemen, I tell you as long as you can put the air to the face it does not make any difference how far the cross-cuts are apart.

John Millhouse: I don't know whether you men are aware of the fact or not, but there are many laws in the present mining laws that are dead. When the Civil Code was made a law it nullified a lot of our laws. After you read the laws as they are today, they are entirely in conflict with the Administrative Code.

Under the Administrative Code the Department of Mines & Minerals was given the administrative powers of the State Mining Law, which practically eliminated the functions of the State Mining Board; that is, under the present set up the State Mining Board does not have the administrative function of the old State Mining Board.

As time goes on, our laws do not fit in as they should do. Many changes have taken place in mining, and every man knows you cannot live up to the letter of the law.

The last legislative commission devoted a lot of time in formulating changes in the mining law. I listened in on a lot of their discussions, and they asked me if their proposed changes suited me. I said, Yes, if you could get them through the legislature. At that time I had no thought that I would be called before the legislature. However, I was called d the best I could, but as you w nothing was done.

e was one proposed change, r, that I was not in favor of, at was the abolishing of the mine inspector. By this I do an that a county that had only ne would be expected to hire But mines are not inspected n as they should be. The in- n of mines by the State and is a free service and shoud be something. I believe in keep- county mine inspector, but I believe in keeping one in county. I believe our State nspectors are over-loaded now, en you go to the working face s time. One thing I regret s that there are more mine in- s interested in what they re- han in the work they do. I they do not take their work as y as they should.

laws need many changes. ou come to the explosive ques- ere are different methods of g down coal being initiated. e improving along that line. rdox method is very interest- But this method as all other has been abused. This method en in limited use for about ears when I took office. It ing used in a dangerous man- d there are men here who hat men had been killed by ying shells used in the Cardox g. I called the attention of nklin county men to this con- We have need of a law for rm of explosive, although at e it is under the shot firers' And now we are getting into method of breaking down coal, ese new methods call for in our laws.

Our laws are obsolete in many ways, and there is need of a change. We have some wonderful mining laws, but they do not fit in with the times. The individual mine does not have power any more, the company has it, and the restriction of that power is a serious proposition for the Department of Mines and Minerals.

There was one other point where I disagreed with our mining commission, and I hated to do it, and that was the exploding of explosives while the men were in the mine. If there is any exploding needing to be done, it should be done when the men are out of the mine.

Wm. Starks: I wish to disagree with our illustrious friend on some points. He speaks of the Mining Board as it is now constituted. The Mining Board has functioned for many years, and I want to tell you today that the Mining Board is functioning and the operators are well represented. Our present Director of Mines & Minerals does not assume any undue authority, and the State Mining Board interprets the law as it thinks it should be interpreted.

The present State Mining Board is going to function as it should. It is not going to enter into any personal or political fights in any way, and we are not going to let either politics or labor troubles enter into any decisions which we may be called upon to give.

John Millhouse: We have had a sorry situation in Illinois as far as labor conditions are concerned. All of our laws seem to have broken down.

Enoch Martin: As I understand it, one of the purposes of this Institute is to foster and promote ideas to make mines a safer place to work.

Laws that are adopted in the legislature are devised from a humanitarian standpoint to protect the fellow who does the menial task and also for the man who directs him.

I wish to assure you that there is no friction whatever between the present State Mining Board and the Director and the Assistant Director of the Department of Mines & Minerals.

C. F. Hamilton: If there is no more discussion on Mr. Jones' paper will ask Mr. Marsh to present his paper on "The Use and Advantages of Light Weight Mining Equipment."

THE USE AND ADVANTAGE OF LIGHT WEIGHT MINING EQUIPMENT

By I. D. MARSH

Supt., Aluminum Ore Co., Belleville, Ill.

Only a few years ago it was believed that extreme weight was necessary in an automobile for control and safety at even moderately high speeds. Until just recent years the railroads continued to build heavier and heavier rolling stock for safety and comfort and as they then thought to make high speeds possible. Today all this is changed and the lightest cars have comfort and speed and safety far beyond that of the heaviest cars of a few years ago. Their light weight design makes the new high speeds possible with entire safety. On the rails new light alloy trains are beginning to change the entire transportation picture, for speed, comfort, safety and lower operating costs bid fair to revolutionize their entire passenger and express carrying problem. In the mining industry comparable progress is being made with reduction in weight a major factor in many cases.

You are all familiar with the gigantic stripping shovels which are today uncovering nearly 20% of the coal mined in Illinois. The 20 cubic yard buckets or dippers for these shovels are commonplace, but dippers up to 30 cubic yard capacity are now being considered, made possible on present shovels by the use of light alloys. In the smaller sizes, through the use of these materials a 5 yard bucket has replaced a 2½ yard bucket and a 16 yard bucket a 12 yard one without other change in the equipment. The reduction in dead weight of the buckets is being turned into increased pay load. This shovel development is recent, however, engineering progress will undoubtedly extend the use of light alloys to the dipper sticks and shovel booms and equipment. It is now common practice to build even the largest drag line booms of light alloys, in fact these materials make the present long boom lengths possible.

As a general rule excessive dead weight is a serious handicap especially where acceleration is eating up power or heavy impact is shortening the life of equipment. Under these conditions the application of strong light alloys can help lower costs and solve many difficult problems. It is now possible to get light alloys in all standard sizes and forms and structural shapes which are equal to struc-

steel in strength per square inch
f one-third the weight. Light
castings and forgings are also
ble in high strength heat
d alloys.
the tipple, screens and con-
are operated which weigh two
ee times the weight of the coal
g over them at capacity, and
re probably at capacity only a
percentage of the time. This
is started and stopped again
0 to 150 times a minute. Re-
weight would reduce vibration,
the needed structure to sup-
nd reduce the power to drive.
acturers are using light alloys
vibrator type screens and con-
and have by this means in-
d the efficiency of these
moving units.
ial type conveyor buckets fab-
d of light alloys reduce their
costs and increase capacity.
ing the weight of cages and
has come in for considerable
sion with many engineers in the
w years and numerous installa-
ave been made in this country
ore especially in Canada, Eng-
Germany, France, Russia,
, etc. What advantage is
by reducing the weight of two
which are in balance is the
uestion usually asked. As the
ons in every shaft are dif-
, no discussion will fit all or
ajority of mines. There are,
er, several factors which are
n to all hoists.
all installations any reduction
weight of the cages will reduce
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ety factor, and rope life. This
also to all elements of the
train from cage chains, rope
s and hitching, bearing loads,
pressures, breaks and anchor-
Cages are only in balance when at rest. The moment they start to move they become unbalanced, the one hoisted increased by its inertia and the other decreased as far as its rope pull is concerned by the same factor. As the hoist acceleration approaches the speed of falling bodies the cage being lowered approaches zero in rope pull regardless of its mass or weight and in the first few seconds where the maximum power loads come, the air speed of the cage is low enough to have little effect. On the other hand every pound hoisted is taking its power toll in accelerated load. So that, though balanced at rest, cages approach a totally unbalanced condition as acceleration approaches the speed of falling bodies and at every intermediate speed the conditions fall in between these two extremes. The peak power loads and total power loads in hoisting should always be reduced by lighter cages and lighter rope loads. The amount of saving would be different for each hoist but as probably one-third of each hoist cycle is acceleration, one-third constant speed and the last third coasting in, the saving would cover fully half the power cycle and if power is used for breaking, the same saving would hold true for deceleration.

There are also several special cases. A hoist which is underpowered could increase its acceleration rate and its capacity by lighter loads. Skips which are limiting the mine capacity, or the bottle neck in the operation, can have part of their dead load replaced by light alloys of high strength and their size increased to greater capacity, without other change. Thus the mine capacity can be increased with the same number of hoists or the old tonnage handled with fewer hoists relieving possible congestion at the bottom and releasing empties quicker. This would be much cheaper and easier than new hoists. In changes to mechanized loading where larger capacity mine cars were needed, new light cages would solve an overloaded hoist condition.

One other condition rather prevalent throughout the coal mines is that many cages have been rebuilt year after year and constantly beefed up and strengthened to enable them to handle the faster hoisting and added abuse. This has overloaded ropes but cages continue to fail. In general these cages have just grew, like Topsy, and considerable improvement could be made by careful engineering and design. Probably in every case adding strength has also added weight which means added shock and impact loads so that the results have been at least partly lost. If, however, added strength were accompanied by less weight and consequently lower stresses great freedom from failure would result.

In the mine a great deal of the equipment must be used and carried about by hand labor. The coal drill has gone through a complete transformation in the past ten years and if any of you were shown today the electric coal drill which we purchased 12 years ago, you would laugh at it, and yet outside of being bulky and weighing about 225 pounds it is a good drill. All the manufacturers of this type of equipment have made great progress but the outstanding accomplishment is reduction in weight. One of the newest drills weighs only 38 pounds. Engineering and design are large factors in this, but all of this equipment today has as a major material, some of the light strong alloys. One of the new developments in fans which has been very successful owes part of its efficiency to the characteristics of its light alloy blades. These are special tools of the mining industry. Two general purpose tools whose new light weight should make them of special interest to us are a safety chain hoist and screw jack. The chain hoist of more or less standard design but using a maximum of light strong alloys, weighing only 58 pounds, would be mighty useful in tight situations which are the rule in the mine. Also a 15 ton screw jack which weighs 19 pounds would be very welcome to the man who had to carry it to the next entry.

The majority of the light alloys are highly resistant to corrosion in mine conditions and so are admirably fitted to its service.

This resistance to weak acid waters and moisture makes their use in the form of a non-skid safety tread plate ideal in escape ways and tipples where painting and other protection is often impossible. Tools also have the added advantage of a permanently bright color and so are easily seen and less apt to be covered up.

One of the most recent developments in special mine tools is a line of rail benders and a punch for the lighter rails. This is a very severe service but here the weight of the tools is a major factor in their efficiency. Here again by some development in design and the use of a strong light heat treated alloy casting, a bender for 25 pound rail and under, weighs less than 20 pounds and has been tested to 58,000 pounds screw pressure before failure. Two other sizes for 40 pound rail and 60 pound rail show similar saving in weight, weighing approximately half that of the best design of older types. The punch designed for 20-25 and 30 pound rails weighs only 26 pounds and should make the fishplating of all inside track and short rail universal

e. It should work equally as or preparing these size rails for ess type bonds.

as not been possible to cover developments and applications reduction in weight was a factor for ease, safety, ny or efficiency in the time at It has rather been my purpose ark upon those applications of light alloys with which I was amiliar and suggest by example ssibilities for development. The acturers are giving the mine or and mine laborer the finest n the world as fast as we call m and has recognized with the f industry that excess dead is waste. It is now possible in vn shops at the mine to take ctor into consideration and with esent tools and equipment use w strong light materials in our and in all those special ap- s which we make for ourselves r it be a hand truck for the or a splint for the safety box.

lon Cargal: Would like to ask arsh what his company has n regard to developing lighter pes for mining machines.

Marsh: Light alloy jack pipes eveloped and they have worked mirably well. We put alum- lloy jack pipes on a loading e for nearly two years now, ey have worked out very well. pipe in the light alloy weighs 18 pounds for a 7 or 8 foot hile an iron or steel pipe of me size will weigh 40 or 50 .

ph F. Joy: In using this um alloy for jack pipes, can they be straightened and retain their original strength?

I. D. Marsh: Yes, they can. But not by heating them. These jack pipes are ordinary double strength pipes, and can be straightened by dropping them across a wooden timber.

Wm. Starks: Mr. Marsh, I understand you are a representative of the Aluminum Ore Company. How can your product be welded?

There are about twenty alloys on the market that are available. The simple alloys, which are not heat treated, can be welded by the oxacetylene torch or the electric arc torch. In the higher strength heat treated alloys welding can be done but it takes out the temper. Will your product respond to electric welding?

I. D. Marsh: Yes, it can be done, but it takes some practice and skill.

C. F. Hamilton: The Chair regrets very much to bring this interesting discussion to a close, but we are running over our time, and will now stand adjourned until after lunch.

AFTERNOON SESSION

Harry Treadwell: This afternoon we will have as our chairman, C. J. Sandoe. I now turn the afternoon session over to Mr. Sandoe.

C. J. Sandoe: I am sure you all realize that it takes a lot of time and effort to get these papers together, and I know you will all give them your earnest attention.

The first paper on the program is "Coal Saw Development and Its Possibilities in Illinois," presented by Joseph F. Joy.

COAL SAW DEVELOPMENT AND ITS POSSIBILITIES IN ILLINOIS MINES

By DEWEY E. JOY
Sullivan Machinery Co., Chicago, Ill.

The ultimate objective of the coal operator is to produce coal of such commercial value that will enable him to not only meet competition but to conduct a profitable business as well. The development and introduction of machines for coal mine use has served greatly to improve mining methods and increase production. Combined, these factors have contributed in no small way toward a reduction in mining costs.

The machinery used at the working face has served to cut the coal, drill for explosives and load the coal into mine cars or some other transporting conveyance. The only remaining operation that was not performed mechanically was the dislodgement of the coal. This has always been accomplished by the use of explosives because it has been considered the only practical and economical means of breaking down the coal.

Until recent years little or no thought was given to the destructive effects that explosives had on the quality of the product. The economic distress through which we have passed since the World war has brought about a changed condition in the industry. The consumer is making more exacting demands on the producer. Quality now governs the available markets more decidedly than ever before and overproduction has served to beat down the prices of the smaller less desirable sizes to such an extent that many mines were forced into idleness because they knew of no available means by which they could improve their situation. "How can I reduce my slack output and obtain a firmer coarse product" became the cry of the hour. As a result, the explosive manufacturer was called upon to furnish a slower and smoother acting powder that would have less shattering effect on the coal. Much experimenting was done in the mines to determine the necessary amount of explosive to properly dislodge a cut of coal and thus improve the efficiency and cost of shooting as well as the quality of the product. Considerable progress was made and the cooperative spirit of the powder manufacturers is to be commended for the time and effort they contributed to this good cause.

It was this trend, however, that attracted the attention of Mr. J. F. Joy about the year 1929 and inspired him to develop a machine that would mine and dislodge the coal without the use of explosives but still prepare the coal in such manner that it could be loaded without difficulty. Through a desire to advance the interests of the coal mining industry this machine, now commonly known as the "Coal Saw" has been perfected and the "Sawing System of Mining" established. This development has since been acquired and is now being marketed by the Sullivan Machinery Company.

The soundness of this new system as well as the design, construction and application of the coal sawing machine has been more firmly estabby the fact that a number of perating companies now have nines completely equipped with aws and have identified them- as producers of Sawed Coal vely. Mines that formerly ed at little or no profit have e use of coal saws, become profitable operations. As a the Coal Saw and the Sawing of Mining have become a of paramount importance to l mining industry.

those yet unfamiliar with the System of Mining and the r in which sawed coal is pro- it may be somewhat difficult alize the simplicity with which be quickly applied to the aver- ine. It is not necessary to from any preferred method vering the coal or change the of the mine. Whether it be room and pillar, long wall or odification thereof, this new e reduces the mining cycle to plest form. The coal is sawed mpletely dislodged from the the seam in one easy opera- It is then loaded in the usual r.

ared to meet any specific re- ents, several types of coal saws w available after having been hly tested under actual oper- onditions. The Type 6-A is a mounted machine which per- all of the sawing operations esting on the mine track. It ble of sawing horizontal slots coal face to a distance of 18 either side of the track center t also saws a vertical slot in l face from the floor to the any point from the center line k to 12 feet on either side. vertical slots may be made to rallel with the track and thus sawing a straight rib. The flexibility of the machine and its ease of operation permits the turning of room necks, crosscuts and the mining of pillar coal without special preparation. It is adapted to use in seams of coal 3 feet thick and upwards to as much as 8 feet. It weighs approximately 6½ tons and can be accommodated by rails weighing 20 pounds to the yard.

The types 51-B and 52-B saws are of a design somewhat different than the type 6-A. They perform all of the sawing operations from the mine floor. They are transported from one working place to another by an independent motor driven truck provided with high and low speeds in either direction. Upon reaching the working place the saw is unloaded and moved to the face by means of steel ropes and self-winding drums. When the sawing cycle is completed the saw is then loaded in the same manner and moved to the next place. These machines are adapted to use in a seam of coal measuring 3 feet in thickness and upwards to 5 feet. They are recommended for use in wide rooms where the width exceeds 12 feet on either side of the track, on long wall faces or with conveyors. The weight is approximately 5 tons, including the transporting truck. Rails of 16 pounds per yard or more is sufficient to sustain this weight for transporting purposes.

Another type designed as 53-B and somewhat similar in design and performance to the 51-B and 52-B is recommended for thin seams measuring from 24 to 48 inches in thickness. This machine saws horizontally at the bottom of the seam only but will shear to a height of 48 inches. Where the coal parts freely from the roof this saw will provide the thin seam operator with all the advantages that the other types will give and at considerable less investment. It may also be used in combination with the hydraulic breaker pad or explosives for dislodging the coal where the coal does not part freely from the roof.

All other previous mentioned types are capable of sawing both horizontal and vertical slots at any point in the face of the seams for which they are recommended. The standard saw slot is 2 inches by 6 feet deep, but the gauge of the cutting teeth may be set to saw a 3 inch slot when desired to meet special conditions. The number of slots necessary to permit dislodging the coal depends upon the thickness of the seam, the location and nature of dirt or bone bands if any, and the general structure and characteristics of the coal. In each instance the coal may be dislodged by the previously mentioned hydraulic breaker pad, an accessory to the coal saw. This pad is inserted in the saw slots and when inflated with oil is capable of exerting a pressure of 150,000 pounds against the sidewalls of the slots. This is more than sufficient to dislodge the cut of coal as well as tough bands of slate and other impurities. The same hydraulic pump that inflates and deflates the breaker pad, is also used to operate the various movements of the coal saw.

The sawing capacity of either type coal saw depends upon the conditions to be met. It is conceded, however, that the track mounted saw has a capacity about one-third greater than either of the floor type machines. This is partly accounted for by reason that a certain amount of time is consumed in unloading and loading the floor type machines upon arriving and leaving the working faces.

Sketch No. 1 illustrates the method of sawing as applied at a mine operating the Straight Creek seam in Southeastern Kentucky. The seam measures approximately 40 inches in thickness including 4 inches of Black Rash next to the roof which comes down with the coal. Rooms are driven 40 feet wide and entries 18 feet. The coal parts freely from the rash and the rash parts freely from the roof. For this reason it is necessary to make one horizontal cut only and it is made at the bottom. The coal sets down as soon as the shear cuts are made at the ribs. Two or 3 additional shear cuts are then made to properly prepare the coal for the miner to load. Loading sawed coal, the men increased their loading capacity 1.5 tons per day. The average per machine shift is 150 tons or about the same as was formerly obtained from shortwall mining machines at this mine. Because the 4 inches of rash is not broken up by explosives and allowed to mix with the coal the ash content of the 2 inch Nut and Slack size was reduced 2 per cent. Six of the 52-B floor type saws have been operating double shift in this mine for 18 months. The maintenance costs including material and labor for tipping the saw chains, oil, grease, repair parts and labor has been 4 cents per ton as compared to

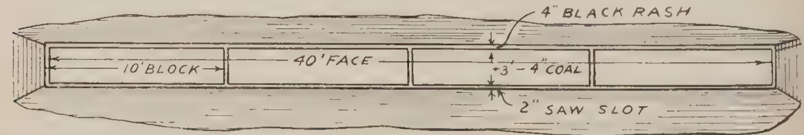
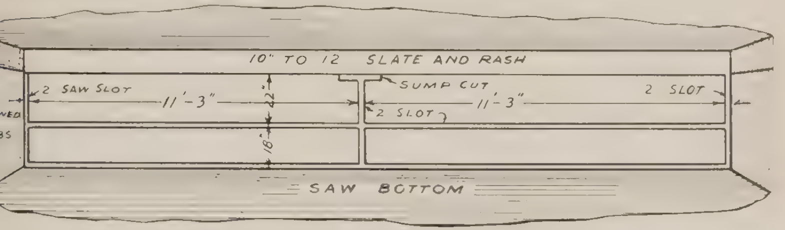


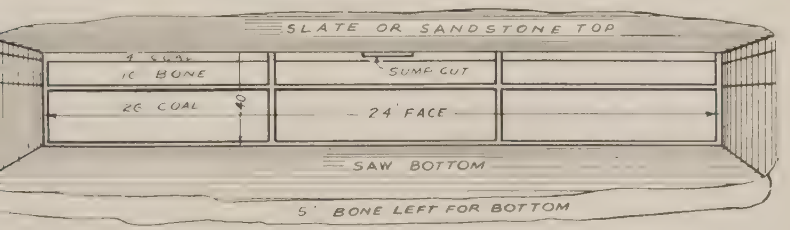
Plate No. 1

Sawing System Used in Straight Creek Seam, Southeastern Kentucky, Sullivan 52-B Floor Type Coal Saw cents for the former shortwall minng machines. The mining machines ad been in service 15 years when iscontinued and I may add that severe cutting conditions exist at this mine.



late No. 2
Sawing System Used in Pocahontas No. 4 Seam, Southern West Virginia, with Sullivan 6-A Track Type Coal Saw, Capacity 220 Tons, 7 Hours

Sketch No. 2 shows the system of sawing used at a mine in Southern Vest Virginia operating the Pocaontas No. 4 Seam. The coal is of a voody structure and lacks any proounced fece or fracture cleats. In his case the bottom cut is made and oth ribs sheared first. The saw lade is then sumped in at the top of he seam near the center of the place nd withdrawn, thus providing a slot nto which the breaker pad is inerted and the full cut of coal disodged. A third shear cut is then nade in the center of the place and ollowed by a horizontal cut about alf way up the seam. In making his last horizontal cut the saw blade tilted up slightly toward the back f the cut and as the saw proceeds cross the place the upper bench of oal keeps breaking off at intervals of about every two feet and slides forward onto the floor. This creates a very favorable preparation and the miners state a preference for loading sawed coal, even though the loading rate is 3½c per ton less than for shot coal. Their loading capacity has increased 1.14 tons per day and they are able to obtain more weight on the cars because they have enough large lumps to put a top on the cars. The type 6-A track mounted saw is used at this mine and has a capacity of 220 tons per 7 hour shift. This is about the same as the shortwall machine and the rate paid the crews is the same in both cases. Maintenance costs have amounted to 1.12c per ton including material and labor for tipping the saw chains, oil, grease,



late No. 3
System of Sawing Pocahontas No. 3 Seam, Type 6-A Track Mounted Coal Saw, 190 Tons, 7 Hour Shift

repair parts and labor. Two saw chains are required to cut 15 places per shift.

Sketch No. 3 illustrates the method used at another mine in the same field. This is the Pocahontas No. 3 Seam, whereas the other was No. 4. The sawing cycle is practically the same. The middle horizontal cut separates the 10 inches of bone from the coal at the bottom of the bone where there is no natural cleavage plane. The top 4 inches of coal parts freely from the bone during the loading process. The bone is accordingly gobed by the miner whereas before it was broken up, by the explosive, and an average of 1,100 pounds loaded in each 3½ ton car and hauled to the surface where the cleaning plant was depended upon to take it out. This resulted in a very substantial reduction in haulage costs and a reduction of 2 per cent in the ash content of the ½ inch slack. The loading rate is the same for sawed coal as for shot coal because of the additional labor of gobing the bone that is now imposed on the miner. No tonnage rate has as yet been established for the saw crew but it is expected that it might be 1c per ton more than the shortwall machine rate. Tests revealed that the degradation which occurred in a 2 ton truck load of sawed coal transported over a rough road for a distance of 15 miles was 25 pounds as compared with 400 pounds for shot coal under the same circumstances and conditions. This is a tremendous market advantage that greatly reduces sales resistance.

Sketch No. 4 is another example of a system as applied in a mine operating the Sewell Seam also in Southern West Virginia. The type 6-A saw is used and has an average of 300 tons per 7 to 8 hour shift. The loading rate is 3c per ton less for the sawed coal than for shot coal at this mine. Loaders on the sawed sections have actually refused to load shot coal. In about 50 per cent of the places the cut sets down after the bottom cut is made and both ribs sheared. When this occurs the saw crew receives 7c per ton. If the cut does not set down the Breaker Pad is inserted in the top of the shear cuts and inflated to move the blocks of coal sidewise and thus loosen them from the top and back of the cut. In such instances the saw crew is paid at the rate of 8c per ton. Sometimes the saw blade is sumped in at the top and the breaker pad inserted there to break the coal down as referred to in Sketch No. 2. The shortwall

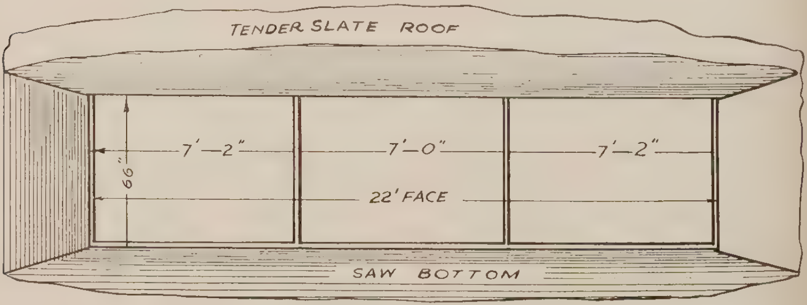
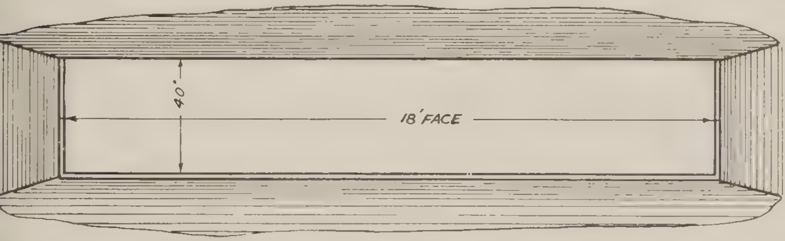


Plate No. 4

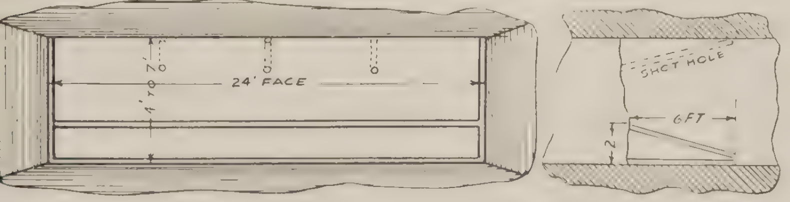
System of Sawing Sewell Seam, Southern West Virginia, Type 6-A Track Type Saw, 300 Tons Per Shift nachine rate at this mine is 6½c er ton or 1c per ton less than for he average rate on the sawed coal. The coal saw has been operating in his mine for 9 months and it is beieved that a lower sawing rate will be obtained at a later date. Thus far repair costs for the saw have been negligible.

Sketch No. 5 covers a mine in Southeastern Kentucky operating the Elkhorn No. 6 Seam. Being a cap- ive mine slack is no problem but the aw is used as a means of obtaining ower cutting costs and the use of ess explosives to dislodge the coal. The type 6-A saw is used to undercut he coal and shear both ribs. It reuires an average of 20 minutes to o this or about ⅔ the time required or the shortwall machine to make ne cut across the bottom. After the awing cycle is completed two holes re drilled as shown and one stick f powder used in each hole to disodge the coal. This compares with 3 holes and 5 sticks of powder for the regular machine cut coal. In the narrow 14 foot entires only one hole is used and one stick of powder to shoot the place. Ten places have been sawed with one saw chain at this mine as compared with 4 places to a set of mining machine bits. The miners show a preference for loading the sawed places but as yet no differential has been established in the loading rates.



late No. 5
System of Sawing Elkhorn No. 6 Seam, Eastern Kentucky, Type 6-A Track Saw, 400 Tons Per Shift

Sketch No. 6 shows another method of sawing as used at a mine in astern Ohio operating in the Pittsurgh No. 8 Seam and also during pecial trial tests in Indiana and outhern Illinois mines. After the bottom cut is made the saw blade is elevated 6 to 12 inches with the point of the blade tilted downward in a manner that it will intersect the bot-



late No. 6
Sawing and Blasting Pittsburgh No. 8 Seam and Experimented with in Indiana No. 5 Illinois No. 6 Seams

tom slot at the back of the cut. This gives a snub effect and serves to roll the coal over when dislodged with explosives. By the addition of shear cuts at each rib this method serves exceptionally well for loading machines because it avoids loader delays caused by tight corners. In the Southern Illinois mine to which I have made reference this last mentioned method was applied where loading machines were in use. The result was 30 tons of coal per pound of powder used for the sawed coal as compared to 8 tons per pound of powder for the regular machine cut coal.

This same method was used in an Indiana mine where Joy Loading Machines were used to load the coal. The seam is 7 feet thick. Three holes were about equally spaced across a 24 foot room and a total of 2½ sticks of powder used to shoot the coal. This compared with 5 holes and 9 sticks of powder for the regular machine cut coal.

We have learned that no matter how lightly the coal is shot or how small the charge it has a shattering effect on the coal. The result is excessive degradation of the product while being handled and transported to market. When coal saws are first installed in a mine it is necessary to advance the working places into the solid a distance of 20 to 30 feet without the use of any explosive before powder stains and shattered coal disappears.

While our experience in sawing coal to be loaded mechanically has been brief we are at present of the opinion that to obtain the most satisfactory results some combination of sawing and shooting will be necessary. We believe Air Shooting will serve this purpose remarkably well because it does not shatter the coal and will therefore permit the highly mechanized mine operator to reap the full benefits from coal saws that are being derived at the hand or conveyor loading operations.

Sketch No. 7 shows the method of sawing adopted at a mine operating in the 5th vein central Illinois field. The coal is dislodged by the Hydraulic Breaker Pad and loaded by hand.

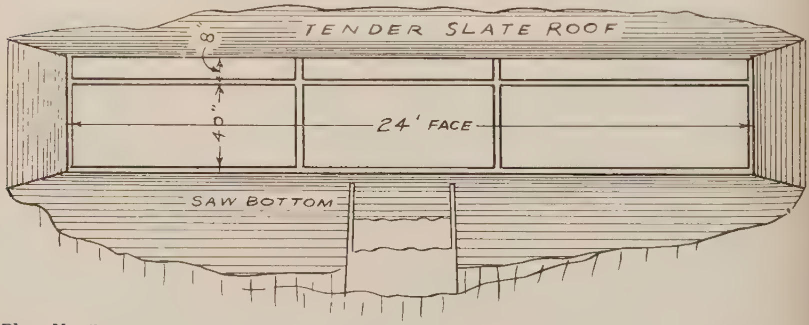
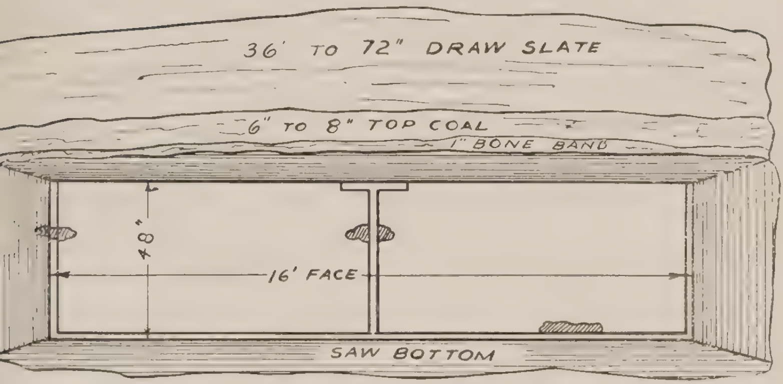


Plate No. 7

System of Sawing Illinois 5th Vein, Central Illinois, Type 6-A Track Saw, 150 Tons, 7 Hour Shift

What has been said of the shattering effects of explosives on the coal is equally true with respect to the roof. Sketch No. 8 illustrates a condition in a mine operating the Pittsburgh Seam in Western Pennsylvania. This coal company abandoned a large



late No. 8
System of Sawing Pittsburgh No. 8 Seam, Western Pennsylvania, Type 6-A Track Saw, 175 Tons, 7 Hour Shift

creage of coal 15 years ago because f the expense of handling a heavy raw Slate which usually came down hen the coal was shot. This slate anges from 36 to 72 inches thick nd when mixed with the coal it was difficult task to clean. A type 6-A oal saw has now been operating in is mine since last August and by e method shown the Draw Slate has een held in place and the mine perated every working day since. ou will notice the thin band of bone nd the 6 to 8 inches of top coal are ft up to help support the slate and eep the air from causing it to slack. p to the time of this writing not a ngle place has been lost since the oal saw was placed in service. Hard lphur balls are very frequent in e coal. It is seldom that a hori- ntal or vertical cut is made that the w does not pass through one or ore of these sulphurs. Two places nd sometimes three are cut with a w chain as compared to 2 sets of ts per place with the mining achines formerly used. The average r the saw at the present time is out 175 tons per 7 hour shift. The ading rate is 4c per ton less for the sawed coal and the rate paid the saw crew is 1c per ton less than the rate for machine cut coal at this mine. The mine furnishes railroad fuel and crushes the lumps to minus 4 inches. The only object in using the saw was to improve the roof condition.

There are many other subjects pertaining to coal saws and their application to different conditions which I believe this audience might be interested in. However, lack of time will not permit dwelling on them in detail. The principal advantage that will apply most generally is the increased realization that may be obtained from increasing the percentage of prepared sizes and improving the firmness and quality of the product to reduce sales resistance. In case of the high volatile coal seams 1¼ to 2 inch slack is generally reduced to half what it formerly was and in the low volatile seams the ½ inch slack is reduced by about ⅙ to ¼. Usually the realization increases 1c per ton on total output for each percent of reduction in slack.

The results obtained from the use of Coal Saws in other fields convinces us that these machines are destined to play an important part in the future mining of Illinois coal. We realize, however, that those operators mining the thick seams in this field and especially those operating the highly mechanized mines, desire a deeper cut of coal than our standard coal saw will permit making. There are no mechanical difficulties to hinder the production of such a machine. Therefore, its development and introduction can be realized when there is an indication of sufficient interest in the equipment to justify the expense of doing so.

C. J. Sandoe: Those of you here who were in Cincinnati saw the machine. But if there are any questions you would like to ask, I am sure Mr. Joy will be glad to answer them.

Harry Treadwell: The present type of machine is more or less rigid and swings away from the track. I am wondering if Mr. Joy's company is figuring on building a more flexible machine.

Joseph F. Joy: I think I am stating the policy of the Sullivan Machinery Company when I say that we are contemplating the building of the type of machine you speak of.

C. J. Sandoe: If there is no more discussion, the next paper will be presented by Mr. Fred Miller on "Use of Air in Breaking Down Coal."

AIR-MINING — THE USE OF AIR FOR BREAKING DOWN COAL

By FRED A. MILLER
Franklin County Coal Co., Herrin, Ill.

The Process Defined

The compounding of the two words, common to the glossary of mining terms—coins a phrase which is truly descriptive of this new development in the science of face preparation—that phrase is "Air-Mining."

Air-Mining cannot be classed in the category of explosives, yet it is used for the same purpose. Basically, the process depends upon the sudden release of a large volume of compressed air from a relative small container previously tamped in the drill hole. Pressure and volume are definitely controlled and are used only in sufficient amounts to break the coal down in a pile loose enough to be consistent with good practice.

How It Acts

The sudden release of air in the drill hole produces a shock much less severe than that which accompanies the detonation of an explosive charge. The first impulse of the expanding air is wedge-like or lever-like in action and the continued expansion literally pushes the coal away from the face. It is therefore void of the disruptive and shattering effects on a friable product such as coal.

The History of Air-Mining

Air-Mining was developed and first applied at the Royalton mine of the Franklin County Coal Company, Inc. It has been in production there for the past three years. At the present time 80 per cent of the mechanical tonnage or 40 per cent of the total mine production is Air-Mined coal.

The Equipment

The equipment as now used at this property consists principally of two parts: one, a mobile compressor capable of building and maintaining a pressure of 12,000 pounds per quare inch, and two, a container or ir bottle for storing the required mount of air in the drill hole.

Air-bottles may vary in size and ethod of air release, but must have ufficient volume and should have a ischarge opening large enough to mpty the bottle as quickly as pos- ible. These two features are of aramount importance in bottle de- ign.

Those used at Royalton are renew- ble disc type with a volume of ap- roximately 400 cubic inches. They re made of 5 inch steel tubing closed t one end and are 4½ inch I. D. ith 2⅝ inch discharge opening and ary in length from 12 to 38 inches. he volume of course varies with the ength and this varies with the depth f the undercut and the amount of ork to be done by any one hole. he discharge opening is offset in the ottle head to allow the entrance of ir through a ¼ inch copper tubing.

The disc is held in place against a harp seal ring by a clamp nut crewed into the bottle head. The lamp nut also acts as the discharge pening and is directed away from he face toward the mouth of the rill hole. The reaction of air when eleased forces the bottle against the olid face and thereby avoids the azard of flying. Pressure is con- olled in this type of bottle by using hicker or thinner discs as conditions ay warrant. We use discs of 12 nd 13 gauge metal. These shear at bout 6,500 and 5,500 pounds per quare inch respectively.

Method of Application

The addition of an Air-Mining unit oes not change the cycle of face peration. Places are undercut and rilled in the regular manner. The umber of holes and their location in he face depends upon conditions and he type of loading equipment used, and is determined by trial and error. It is our practice to use 3 bottom and 3 top holes in places 28 to 30 feet wide and 2 bottom and 2 top holes in entries and narrow places 12 to 14 feet wide. Empty bottles are placed in the holes and tamped, leaving a short length of copper tubing protruding from the hole for connection to the compressor air line. After all holes in the place are ready, the compressor moves in and stops about 70 feet from the face. The air line is connected to the bottle tubing and the compressor started. Air is forced into the bottle until the disc is ruptured and the compressed air released. This operation generally requires 2½ minutes. The compressor is stopped—the operator goes to the face, connects to another bottle and carries the discharged one back to the compressor. This cycle is repeated until all bottles are discharged and the place is ready for the loader. The second man of the crew, who also acts as trip rider and general helper, inserts a new disc in the discharged bottle and makes it ready for use again. The Air-Miner and its crew then moves to the next place, and the operation is repeated.

In our mining practice two compressor shifts keep four mechanical loading units supplied with coal. The day shift operation is continuous and serves two loading units located on opposite sides of a panel entry. At night the same compressor operated by another crew, makes coal for the other two units in different territories.

Advantages and Disadvantages

Our experience in the development and application of Air-Mining has revealed several noteworthy features which we consider advantageous to the convenient operation of a coal mine. These are probably best cited by discussing the relative merits as compared to other processes used for the same purpose. Since our experience is limited to explosive and Air-Mining methods, the comparative advantages and disadvantages are likewise drawn between these two. The disadvantages of the process are cited first.

Disadvantages

1. To begin with a capital investment is required for equipment which in all probability is greater than the investment tied up in explosives at any one time. Note—To the best of my knowledge no definite price has been placed on equipment at the time of this writing.

2. Drilling may become more complicated because the holes are larger than those required for powder. The selection of more powerful drilling equipment overcame this difficulty in our case.

3. The addition of an Air-Mining unit adds another piece of mechanical equipment to the mine and consequently means more work for the inspection and maintenance staff.

4. The compressor naturally puts another load on the power system. The demand may vary from 30 to 60 K. W. depending upon the pressure and speed at which it is developed.

5. Upon installation this additional equipment is apt to congest the haulage system somewhat, although this feature is not serious, it is inconvenient until the personnel becomes accustomed to the schedule of movements.

And now for the advantages of the process.

Advantages

1. One of the most important features of Air-Mining is Safety. In addition to eliminating the hazards and evils associated with the storing, handling and use of explosives, it is important to note that loose coal hanging to the face and ribs of an Air-Mined place is almost entirely eliminated. The danger of loose coal falling on machine men, drillers and other face employees is reduced to a minimum. The equipment is never in a charged or dangerous state when handled. It is inert until the compression period is started. There is no receiver on the compressor—the bottle tamped in the drill hole acts as the receiver. The air lines are of copper tubing or high grade alloy steel—should one of them burst under pressure the volume of air released is too small to be of any consequence. The operator and helper are protected from flying coal by shields erected at their respective stations.

2. The mild action of compressed air, as compared to explosives, gives utmost consideration to tender roof conditions. We have made no tests with precision instruments to determine the difference in roof shock, yet

FIRST TEST

Sizes	Powder-Mined	Air-Mined
Refuse	6.40%	6.10%
6″ Lump	11.55%	28.60%
6x3 Furnace	18.30%	17.85%
3x2 No. 1 N.	10.85%	8.65%
2″ Scgs.	52.90%	38.80%
Total	100.00%	100.00%

SECOND TEST

Sizes	Powder-Mined	Air-Mined
6″ Lump	14.60%	24.00%
6x3 Furnace	18.25%	21.50%
3x2 No. 1	11.45%	8.65%
2x1½ No. 2	7.75%	9.40%
1½x¾ No. 3	9.80%	10.35%
¾x5/16 No. 4	15.75%	8.60%
5/16x0 No. 5	22.40%	17.50%
Total	100.00%	100.00%

t is significant to note that Air-Ming methods reduced roof falls substantially as compared to powder-mining methods in the same terri- ory.

3. Air-Mining produces a greater ercentage of large size coal at the xpense of the finer sizes. The pre- eding table shows results of specific creen tests and are indicative of the ange of sizes which can be obtained y use of the process:

To those of us interested in in- reased realization by the production f more big coal, this feature is at- ractive.

4. Air-Mined coal is firm and ubject to less degradation on andling. First, because it is dis- odged in a much more gentle manner t the face and second because it is ot filled with minute powder cracks vhich cause breakage and rapid veathering. Those of you who handle ustomer complaints will appreciate he fact that Air-Mined coal stores etter and is therefore more desirable n domestic sizes.

5. In Air-Mining the tamping con- ists of moist drill cuttings; there is o ash bearing material added to the oal pile as in the case of powder- nining where incombustible stem- ning is recommended.

6. Air-Mining is accomplished on he working shift and where state nining laws prohibit the firing of hots on shift, this feature is espe- ially attractive. It makes possible the dvancement of a working face more han one fall per shift, which, under llinois law, is impossible with explo- ives.

7. Air-Mining allows a mechanical oading unit to be confined in fewer vorking places. While this feature s dependent on conditions, it does ffer possible savings in material by etter concentration.

8. As a general rule there is less digging for the loader to do in an Air-Mined place than in a powder-mined place. In our attempt to obtain the best grade of coal possible with permissible powder, we have experienced difficulty in loading because the coal has a tendency to merely drop-down in the space formerly occupied by the kerf. This coal is thoroughly and completely shattered, yet it remains in a more or less standing condition and is sometimes hard to load.

9. Air-Mining is not a labor saving process. The greater part of the money ordinarily spent for explosives is spent on labor. This fact has a favorable bearing on the attitude of the men and the introduction of Air-Mining equipment is viewed with much less disfavor than the introduction of some other mechanical equipment.

10. Air-Mining is economical. We realize the impossibility of comparing costs on anything unless we talk of the same items and all sets of figures are reduced to a common basis. The charges which constitute our operating costs for the same work under both methods are composed of the items shown on the following page.

Total Operating Cost

Under Operating Labor, drilling in both cases is the same.

Shotfiring labor and labor required for delivering powder is chargeable only to powder-mining, while compressor labor is an item of air-mining only.

Operating Supplies in the case of powder-mining consists of powder, caps, fuse, drill bits and sundry items such as tamping bags and tools. In air-mining this same charge covers discs, tubing, drill bits and similar sundry items.

ITEMS	POWDER-MINING	AIR-MINING
Operating Labor—		
Drill Labor	X	X
Shotfiring	X	
Handling Powder	X	
Compressor Labor		X
Operating Supplies—		
Blasting Supplies	X	
Air-Miner Supplies		X
Repair Labor—		
Drills	X	X
Compressor		X
Bottles		X
Repair Supplies—		
Drills	X	X
Compressor		X
Bottles		X

Repair Labor and Repair Supplies to drills cover the same items under both processes, while Repair Labor and Repair Supplies to compressor and bottles are items of air-mining.

No mention is made of the cost of investment since this may be handled in a number of different manners.

The cost of power is likewise omitted since our costs include all power under a separate schedule.

So, without attempting to assign a dollar and cent value to any of the advantages or disadvantages of either method but pitting only like charges against like charges, the economy of air-mining is evidenced by the fact that our air-mining operating costs are not only comparable to our powder-mining costs but in recent instances we have even bettered them.

When we consider that these costs and conclusions are compiled from operating data obtained by use of the first two compressor units ever built for this service and knowing that air-mining costs are largely dependent on compressor performance, we have good reason to believe that improved compressor design and construction, together with natural improvements in process application, can and will substantially reduce these costs in future operations.

C. J. Sandoe: I am going to ask Mr. Skinner of Standard Coal Company of Wheatland, Indiana, to give us some of his views on air shooting.

S. E. Skinner: The only thing I can tell you on air shooting is just what I have observed at our own property. We have one air shooting unit at our plant. Mr. Miller uses a larger shell at his plant than we use.

We have found air shooting to be a very satisfactory method in dislodging coal. We have a 6 foot undercut in 8 or 9 foot coal, and the only difficulty we have run into is keeping our track up to the coal face, and we are attempting to overcome that by cutting our coal with a caterpillar type cutting machine.

There is only one suggestion I would want to make to the manufacturer of the air machine, and that is to make it easier to move from place to place.

C. J. Sandoe: If there is no more discussion on Mr. Miller's paper we will proceed to the third paper of the afternoon "Versatility of Permissible Explosives," by R. Y. Colclesser.

VERSATILITY OF PERMISSIBLE EXPLOSIVES

By R. Y. COLCLESSER
Technical Representative, E. I. du Pont de Nemours & Co.

As applying to permissible explosives, we would define versatility as the faculty of providing a safe force for the dislodgment of coal under the many conditions which occur in coal mining. This is indeed a wide and varied field when it is considered under just what conditions permissibles have been asked to break the coal in a manner such that it can be loaded.

In some instances, we find the coal is neither undercut nor sheared and the permissibles are used to blow the coal out of the solid. In other cases the coal is undercut. Some operations both undercut and shear. In still others the coal is top cut.

In order to fit in with the cycle of operations at the different mines, we find many different arrangements are made in the drilling and shooting: (1) The Coal may be drilled and shot by each individual loader; (2) the Coal may be drilled by the loader and shot by a shot firer who comes to the working face either on the shift or at night after the miner leaves his working place; (3) the coal may be drilled and shot by the Company men and the coal loaded by the miner; (4) the coal may be drilled and shot by the Company and loaded with some mechanical device.

In addition to all of the above, we have the seams of coal with their various heights, textures and percentages and kinds of impurities. They might even be further classified as to dry and wet work.

The explosive manufacturer in order to make the permissible really versatile in the true sense of the word to comply with these conditions has found in the first place that the explosives must be supplied in such a form that it can be placed in the bore hole to the best advantage. In other words, in each seam of Coal there is a certain length of explosive in the bore hole which is the most efficient. This can be adjusted by the different diameters of Cartridge. As commonly used, the diameter of permissible explosives varies from 1⅛″ to 1¾″. Where the coal is drilled by hand, this Cartridge diameter is somewhat determined by the ease with which drilling can be done. In hand drilling a piece of coal, extra labor is involved in a large diameter hole and more impurities are encountered in the drilling. Often in hand drilling the execution of the explosive may be somewhat impaired in order to cut down on the labor of drilling. Hence the necessity for the different diameters and the explosive content must be such that the permissible is satisfactorily sensitive in the small as well as the large diameter Cartridge.

Next there is the question of density; in other words, the Cartridge Count of the explosive per 50 pounds of explosive. To fit in with the different seams of coal with maximum efficiency it has been found necessary to vary the density of the permissible. Different cutting methods may require the consideration of density. Finally, actual results would indicate that, other conditions being the same, mechanical loading would require a different density of permissible when mechanical loading displaces hand loading. At the present time we are furnishing ammonia nitrate permissibiles which range in density from 100 Cartridges 1¾ x 6 to the 50 pounds to 180 Cartridges 1¾ x 6 to the 50 pounds. As originally made the permissibles were nitroglycerine types and the flame was quenched by the addition of either free water or salts containing a high percentage of water of crystallization. These were not very satisfactory in execution and the ammonia nitrate type has displaced them almost entirely. However, the ammonia nitrate type of permissible has its limitations for it is susceptible to moisture in the bore hole. A permissible list composed entirely of ammonia nitrate permissibles, is not, therefore, what could be called versatile. For conditions of excess moisture we have the gelatin type permissibles. These are water resisting and do not lose their strength or their permissible qualities when placed in contact with water. In addition these gelatin permissibles are stronger per unit of volume than the ammonia permissibles. They are well adapted to rock work encountered in coal mines. With them we have an efficient agent for shooting rock in a dusty or gassy mine.

Permissible explosives give off less smoke than any other type of coal mine explosive. This property is especially important where miners return to the face and load coal after shots fired on the shift. It is this high rating in fumes which causes many mines to use permissible which would ordinarily use black blasting powder. In order that a selection of permissibles may be made on the basis of fumes produced, the U. S. Bureau gives the ratings of A, B or C on all permissibles listed by the Bureau. Another factor which has contributed to the versatility of permissibles is the different detonating speeds. The proper detonating speed of permissible for a seam of coal is determined by trial. It is a fallacy to say that every coal seam is necessarily worked to the best advantage by the permissible having the lowest detonating speed in the Bureau of Mines list. At the present time, we are furnishing permissibles varying in detonating speed from 5940 feet per second to 14,970 feet per second.

Regarding the firing of permissible, it may be fired with either an electric blasting cap or cap and fuse. Neither method requires much equipment. In connection with electric firing at the present time, electric blasting caps are being furnished with shunt or short circuited wires to eliminate hazard from stray current in the mine. The electric firing of permissible explosives may be taken advantage of where a number of shots are to be fired at one instant in order to get best efficiency on certain types of work.

As to storage in the mine, the permissible affords a form of energy which may be stored in a very small quantity in each working place or may be stored in one central magazine. It may be carried in a knapsack by the shooter to the working face without interfering with transportation of coal or mechanical equipment.

In considering the versatility of permissible a very important item is the cost per ton of coal shot with permissible. The present permissible explosives have proven to be a very economical agent for the purpose of shooting coal. In addition the investment incurred is only proportional to the amount of energy necessary to shoot the coal in the mine for a comparatively short time.

It was the property of safety in a dusty or gassy mine which originally gave it the name of permissible explosive and in all modifications to meet varied conditions, the permissible feature is not violated. Each permissible is furnished of such quality that when loaded in the bore hole at the mine it will detonate in such a manner as to make it safe for use in a gassy or dusty mine.

In this paper I have endeavored to bring to your attention some of the characteristics which make permissible explosives a versatile force in the shooting of coal under the conditions as they are encountered in coal mining. The modern mine has hown great progress in the methods employed in mining coal and the permissible explosive has been developed and improved to keep in step with these changes.

C. J. Sandoe: Is there any discussion on Mr. Colclesser's paper? If not, we will finish our program at this session, as we have decided to continue this meeting and have everything over with this afternoon, as you know we will be unable to make the trip through the penitentiary at Chester and have plenty of time. So we will now have the presentation by Prof. D. R. Mitchell, University of Illinois, on curriculum of the University Mining School.

MINING ENGINEERING AND EDUCATIONAL PROBLEMS PERTAINING THERETO — A CATECHISM

By D. R. MITCHELL
Assistant Professor of Mining and Metallurgical Engineering,
University of Illinois, Urbana, Ill.

What is Mining Engineering? Minng Engineering may be defined as hat part of the engineering profesion dealing with the application of cientific and technical knowledge to he problems of discovery, exploitaion, design, development and operaion of coal, oil, metallic and nonmetallic mineral deposits. A wellqualified mining engineer must have bilities and training, not only in mining, but in many sciences and ther branches of engineering. He must sometimes be a manager, as well, able to conduct complex and xacting business and banking operations.

Have the duties of a Mining Engieer always been broad? Yes. Agriola writing in his famous book "De Re Metallica" published in Latin in 1556 gives his opinion of "what a **miner** should know," the term miner being used in the sense mining engineering is used today. His remarks are briefed as follows:

Geology; "that he may know what mountain, what valley—can be prospected most profitably." Chemistry and mineralogy; "that he must be familiar with the many varied species of earths — metals — compounds." Mining; "he must have a complete knowledge of making all underground works." Metallurgy; "Lastly, there are the various systems of assaying and of preparing substances for smelting." General Sciences; "there are many arts and sciences of which the miner should not be ignorant. First, philosophy, that he may discern the origin, cause and nature of sub-

Assaying Ores for Gold and Silver

terranean things. Second, medicine, that he may be able to look after the health of his diggers. Third, astronomy, that he may judge the direction of the veins. Fourth, surveying, that he may be able to estimate how deep a shaft should be sunk. Fifth, arithmetical science—that he may calculate the cost in the working of the mine. Sixthly, architecture, that he himself may construct the various machines and timber work required underground. Next, he must have a knowledge of drawing. Lastly, there is the law . . ."

Have the duties of a Mining Engineer changed materially during the past 30 years? Fundamentally, no. Years ago it was expected that the mining engineer would do all the engineering work involved in the operation of a small property, whether it was civil, mechanical, electrical, or chemical and manage the business affairs. With the growth of large corporations many branches of engineering are used and there is an increasing tendency toward specialization in various fields of mineral production, preparation, marketing and utilization.

What Relation does the Mining Engineer have to the other engineering professions involved in mineral production? In general the use of engineering talent for mineral production can be classed as follows:

The Civil Engineer—for construction purposes.

The Mechanical Engineer —for better machinery.

The Electrical Engineer—for efficient use of electrical power.

Class Work in Mine Surveying

The Mining Engineer—to learn d operate the business.

That the mining engineer has been ccessful in the general field of the siness of production of minerals ether it be metallic ores, non-etals, coal, petroleum or natural gas is apparent by the fact that so many of the managers, superintendents and higher executives of mining companies are graduate mining engineers.

Are there opportunities for specialization in mining engineering?

Probably more opportunities than

in any other profession, including medicine. The general practitioner is being replaced by various specialists although the mining engineer who specializes in management must be and is particularly adapted by training to correlate and utilize the findings of specialists in various departments of his organization. However, the engineer who is particularly interested in some special technology has plenty of opportunity to specialize. Geophysical prospecting, ventilation, haulage, mining methods, mechanical and electrical applications, coal preparation and ore dressing, safety, and economics are all inviting fields.

Is there any pronounced characteristic of the field of minerals as compared with other commodities? Yes. Tryon[1] states that: "There are four distinguishing facts about minerals—localized occurrence, uncertainties of discovery, tendency to increasing cost and to a lesser degree accumulation of stocks—that cut across all problems involving the minerals. They cut across national defense, labor relations, tariffs, taxation, price movements, laws of property rights, production control, valuation and management of the public domain. Suffice it that wise decision on any one of these questions requires a peculiar type of training to understand and evaluate. It involves a knowledge of the resources and puts a premium on mining engineering, geology and mineral economics." "That is why, no doubt, the professional economist has passed the field of mineral economics by and why most of that which has been done comes from the technicians."

"We who work in the world of minerals are continually impressed with the individuality of its problems. It is a world where strong cross-currents are always flowing and he that fails to reckon with them may go far astray."

What opportunity has the mining engineer for foreign work? The current issue (1934) of the annual Directory of the American Institute of Mining and Metallurgical Engineers shows that members resided in 73 countries other than the United States. The editor of Mining and Metallurgy, in discussing this, points out the following: "It is true that 16 of the 73 countries are represented by a single member, but it is also true that 20 of them each has 20 or more resident members. This figure exceeds the corresponding number of countries that are thus represented in the membership of any of the other Founder Societies despite the fact that each of the three has a membership from two to three times that of the A. I. M. E. The following percentages show the proportion of the total membership of the four Societies that lives outside the United States: Mechanical Engineers, 5; Civil Engineers, 6; Electrical Engineers, 13; Mining Engineers, 30."

"With respect to the Mining Engineers, the preponderant number of the foreign residents are American citizens sojourning abroad in the practice of their profession, though the number of nationals of other countries is by no means negligible. The significance of these data is clear: Mining and metallurgical operations throughout the world are conducted primarily by American engineers, with British engineers (including those from the Dominions) constituting the only other group of importance. At that, they are not a particularly close second. Fortunately, and to the credit of the profession, nationality is allowed to cut little figure when it comes to the engineering side of the exploitation of minerals."

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[1] F. G. Tryon, Mineral Ec. pp. 10 and 26.

What effect has the depression had on employment? At Illinois we have had practically no unemployment of mining engineering graduates. Insofar as we know all of our alumni are working except this year's graduating class who, we believe, will all be placed during the summer months. The mining engineer has probably weathered the depression better than other professional groups.

What type of work do the graduates at Illinois usually follow? Employment by manufacturers of mining machinery and in other mine service industries, in metal mines, non-metallic mines, oil and gas production, and a few with coal producing companies.

Do most of the mining graduates at Illinois follow the profession of mining engineering? Approximately 95% of our graduates are engaged either directly in mineral production or some closely allied line such as with mining machinery manufacturers.

How does that compare with other engineering professions? Reliable estimates for some of the more popular engineering courses show that from 20-50% of the graduates follow their profession.

What is the relation of number of students in mining schools to the annual value of mineral products in the various states? Dean Steidle of Pennsylvania State College analyzed this situation in 1929 and reached the conclusion that in some sections of the United States there was a striking lack of technical students in process of being trained for mineral industry positions. His figures giving the number of students enrolled per each ten million dollars of primary mineral products in the same state, follow:

North and South Dakota	70.0
Colorado	19.8
New Mexico	18.1
Washington	16.5
Idaho	14.8
Missouri	12.0
Michigan	9.5
Montana and Wyoming	9.1
Nevada	8.0
Wisconsin	7.1
Minnesota	5.8
Arizona	3.2
California and Oregon	3.0
Pennsylvania	2.4
West Virginia, Kentucky, Virginia, Alabama, Georgia and North Carolina	2.0
Illinois, Indiana, Iowa, Kansas	0.5
New York and New Jersey	0.5

Students in metallurgy proper, ceramics, coal-processing, oil refining, mining, quarrying, oil and gas production are included in this tabulation.

Is there a need for mining engineers in the coal industry? There appears to be a need but practically no demand. Metal mining companies allow from 4 to 6 per cent of their total expenditures for engineering design, supervision and research. The building industries commonly use about 5 per cent and in some cases as high as 10 per cent. The coal industry is a highly technical industry that involves the expenditure of large sums of money and it appears to many of us that every dollar of this expenditure should be regulated and controlled by engineers, whether it be for production, preparation or research. It is true that the anthracite producers and certain eastern operators are spending probably as much for engineering services as the metal mining companies but bituminous operators in general are spending less

Laboratory Instruction in Mine Lighting and Mine Safety

than 1 per cent and some spend practically nothing for engineering.

One important oil company that operates in the Mid-Continent field and for which I have the information, is spending a little more than 6 per cent of its annual gross expenditure on engineering.

Is the field of mining engineering oversupplied? It appears not. Mr. Howard N. Eavenson, a prominent consulting coal mining engineer and President of the A. I. M. E. is quoted, on the editorial pages of the May, 1934, issue of Mining and Metallurgy: "During the past five years, and in some respects for longer than that, only one great industry has suffered more from the depression than mining. Only the farms have had greater losses and have given less return than the mines. This condition has not been an attractive one for our young men and consequently the number of students taking mining courses has decreased. The mining students of today are the mining engineers of the future, and the present situation is not a reassuring one for the older men in the profession, many of whom have been through a number of depressions and who forsee, in the not far future, a dearth of trained men capable of filling executive positions in the industry." "The Institute wants to keep those who are now taking mining courses **in the industry** and to attract more men of high calibre to our colleges and universities."

How does enrollment in mining courses at the present time compare with previous years? There has been very little change at Illinois during the last five years. In fact, at Illinois, the enrollment is slightly higher than it was in 1930 but is only half what it was 10 years ago. We have practically no one taking coal mining. Our students apparently feel that there are more opportunities in fields other than coal.

Professor Plank of Lafayette College at Easton, Pennsylvania, has made a careful study of the trends in enrollment in Mineral Technology courses and expresses the opinion that by 1937 there will be a marked dearth of competent and adequately trained professional engineers, particularly mining engineers. The following table gives the enrollment in the 46 institutions offering mineral technology courses.

Enrollment in Mineral Technology Courses

	1921-22	1932-33	1933-34
Mining	3,256	1,393	1,161
Metallurgy	239	1,288	937
Petroleum and Natural Gas	2	726	681
Ceramics	156	522	629
Geology	17	387	438
Fuel Technology	----	67	70
Not Differentiated	----	60	79
	3,670	4,443	3,995

What is the occupation of the fathers of the boys taking mining? For the year 1933-34, 24 students were registered in mining engineering at Illinois who listed their father's occupation as follows:

Father's Occupation	**No.**
Metallurgical Engineering	1
Mechanical Engineering	1
Editors	2
Real Estate	1
Clerk	1
Cashier	1
Merchant	2
Doctor	1
Skilled labor	2
R. R. Engineer	1
Barber	2
Office Manager	1
Farmer	4
Laborer	1
Mine official	2
Miner	1
Total	24

It is apparent that boys with a mining background are not interested in mining engineering as a profession.

What type of work do boys from mining families take at college? One hundred one boys were registered this year at Illinois who gave as their fathers' occupation either miner, mine official, executive or owner. They were distributed in the various colleges in the University as follows:

Mine Officials, Executives or Owners, 28; Miners, 73; Total, 101

	Med.	P. E.	Eng.	Agr.	Com.	Dent.	Phar.	Jour.	Fine and App. Arts	L. A. S.	Law	Educ.	
Officials	2	1	7	1	2	2	0	1	2	9	1	0	28
Miners	3	6	16	4	10	2	0	1	1	24	4	2	73

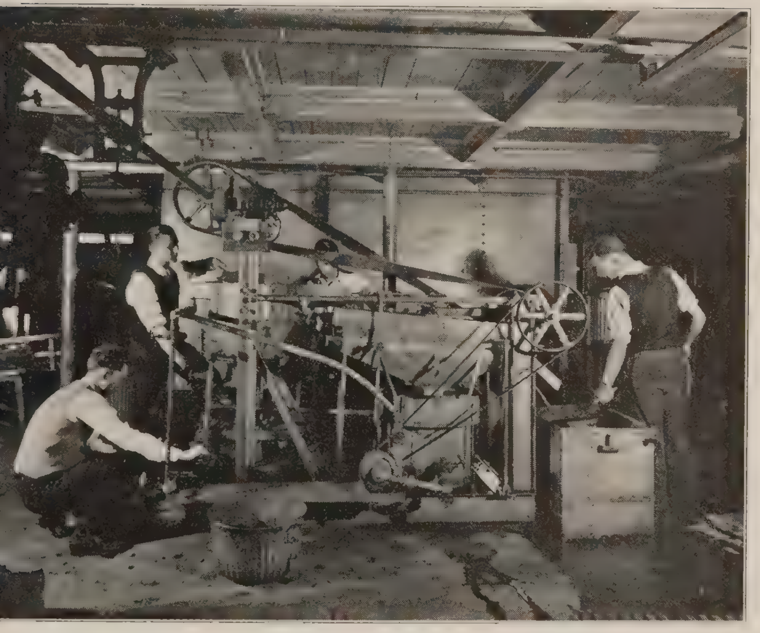
Senior Mining Engineering Students on Inspection Trip to Fluorspar Mine, Hardin County, Illinois

Is mining engineering passing? If we take the biologist's principle that the more specialized forms of life tend to disappear while the general types endure, then the mining engineer with his broad training should be particularly fitted to adapt himself to changes. Fundamentals endure while freak educational policies usually have a short life. At Illinois, we believe that we are on the right track by stressing the fundamentals with a minimum of specialization. The place for specialization is in industry or in graduate work.

What is the biggest problem of the undergraduate student at Illinois? That of finding summer employment is probably the greatest. It is very important that students have summer employment in or around the mines if possible. Some companies co-operate in this matter and are of real service to the student. It is the only chance for the student to get acquainted with actual mining operations. Most of our boys must go outside the state in order to get the experience we so much desire them to have and which they are eager to obtain. A number of our students are working their way through school and the money they can earn at labor or other jobs is usually sufficient to pay their fees and by working for their room and board they are thus assured of another year on the campus.

Most of the summer jobs are in other states and in some instances the boys have had to go considerable distances to get jobs. We have sent boys to Arizona, Oregon, Oklahoma and even to mines in Canada. In 1930 one company in Oklahoma took four boys.

During the last three years it has been increasingly hard for students to find summer jobs. We were heartened this summer by a letter from one of the fluorspar companies in southern Illinois stating that they could put two boys to work underground.



A Class in Coal Preparation

don't believe that any of our ents have worked in or around oal mines in Illinois during the ner months in recent years. e are two coal companies in the burgh district of Pennsylvania often take a likely young man plan on working him into their nization on graduation.

hat are the chances for employ- after graduation? We believe are better than in most profes- . All our graduates have jobs ar as we know.

the field of coal mining, we have three inquiries for men during ast year with no one to recom- l. The year before, I recall at one request for a man with a mining company for which we no one available.

What is the nature of the present day mining curriculum at Illinois? Mining education at the present time presents something of a paradox. It is general and fundamental yet at the same time increasingly leaning towards specialization. However, specialization is obtained by using electives in an orderly manner without disturbing the comprehensive, fundamental training desirable in the sciences and electrical and mechanical engineering. In fact the student electing the coal option in mining engineering can still specialize further in either electrical or mechanical engineering using the electives available in the curriculum. One of our recent graduates, who is making good in a big way with one of the large eastern coal operators, had nearly enough credits to get a degree in electrical engineering in addition to his mining engineering degree. Four options are available at Illinois in mining engineering—coal mining, ore mining, mine administration and mining geology.

In addition, a full curriculum in metallurgical engineering was established during the past year and is now in operation.

What Fields of Work are open for the Coal Mining Engineer? Graduates may enter the employ of coal mining companies in the egineering, operation or sales departments. Service organizations for the coal industry employ coal mining graduates for sales and demonstration purposes.

What Fields of Work are open for Ore Mining Engineers? Opportunities are available in various departments with ore mining companies, including engineering, mine operation, and ore dressing. Also, opportunities with service organizations in sales, demonstration, and engineering.

What Fields of Work are open for those Graduating in the Mine Administration Option? This option gives the student an opportunity to take considerable work in economics, accounting, finance and administration which particularly fits him for entrance into sales, and administrative divisions of the industry.

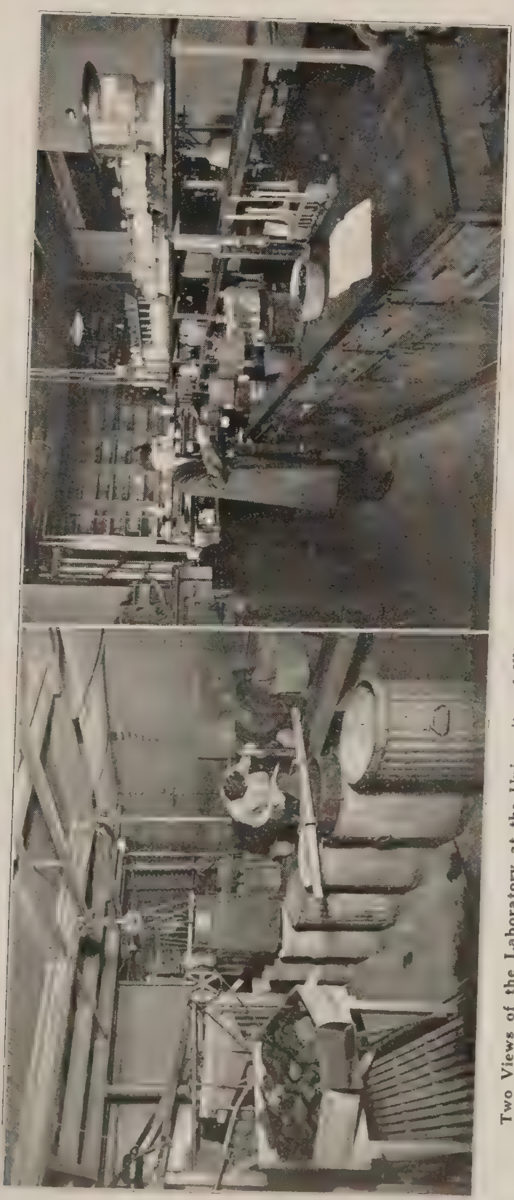
What Fields of Work for those Graduating in the Mining Geology Option? There exists now a definite demand for men who have an education in engineering along with their geological training and this is provided for in this course. The mining geologist, or geological engineer has won for himself a prominent place in many technical enterprises related to ore and coal mining, petroleum production, civil engineering and water supply.

What are the Opportunities for Metallurgical Engineers? The world is using metals as never before. There is scarcely an advance in our modern industrial civilization which has not depended on metallurgy. Aircraft of all kinds, streamlined trains, ocean liners, high speed automobiles, skyscrapers, etc., are only made safe and efficient by the work of the metallurgist. Metals are tailor-made, as it were, to do a particular job better than ever before. Hence, many lines of endeavor are available to the metallurgical engineer in metal production, fabrication and utilization.

C. J. Sandoe: Is there any discussion on Prof. Mitchell's paper?

John A. Garcia: I had felt sure that I am a mining engineer, and now I have found out what I am supposed to know. It so happens that it was just 34 years ago today that a big-bellied professor gave me a sheep skin.

As to mining engineering, I do not want to detract from Mr. Mitchell's paper, but as to a man who is capable of designing, buying and building and putting into operation a coal mine, there is no such thing. A mining engineer is a man who has a knowledge of many things, and uses his organization to do those things, and does not do it himself.



Two Views of the Laboratory at the University of Illinois Showing Some of the University's Many Facilities for Coal Analysis, Study and Research

THE ART OF CLEANING COAL

By COLONEL EDWARD O'TOOLE

American Coal Cleaning Co., Welch, West Virginia

"Coal Cleaning," or generally called "Coal Washing," is a term applied to the separation of coal from its impurities. Fundamentally, it is a gravitational process, based upon the difference in the specific gravity or weight of the components comprising the mixture. To bring about an economical separation of the light components consisting of coal from the heavier components or impurities, water was first employed as a floating medium. Since the specific gravity of water is somewhat lower than that of the coal, it was necessary to set up a turbulence in the water to keep the coal in suspension and allow the impurities or the heavy components to sink. The suspended coal is carried away by the flow of the water, while the sink is removed by mechanical means.

Coal is a rock, not a mineral, composed of combustible and incombustible substances. Oftentimes, the combustible and incombustible ingredients comprising the coal mass are so thoroughly intermixed that such coals have little or no value as fuels unless washed. In cases where the combustibles and incombustibles do not constitute a loose mixture, the coal must be crushed or pulverized in order to free one from the other to form a loose mixture capable of separation.

In mining, coal is broken into a mass that comes from the mine as a mixture. The incombustible particles are mixed in various proportions with the coal. The greater the percentage of these incombustible particles in the mixture, the poorer the grade of coal.

In the early part of the 19th century, the separation of the incombustible and semi-incombustible material from coal by gravitation was introduced into coal cleaning, and the Art of Washing Coal was born. This art has been developed by succeeding generations, until at the present time, it has reached a high degree of perfection and the terms Cleaning and Washing of Coal have become synonymous.

In order to further liberate the solid inerts from the coal, grinding and crushing the raw material to a smaller size was introduced into the art of coal preparation. This crushing process in reducing the size of the coal particles, also greatly increased the surface exposed and in the washing process the coal retained a large amount of moisture. While the solid inerts were more efficiently removed, yet the additional moisture absorbed, more than offset this advantage as moisture is also an inert.

The Art then took up the problem of removing this surplus moisture or water from the coal. Many devices have been designed, applied, and are now in use for this purpose. But they are only partially successful and even the most efficiently designed mechanical dryers still leave a greater percentage of water in the cleaned coal than the percentage of the solid inerts removed, and at present, heat is being applied to drive off the water left in the coal by the washing. The result is that the installation and operation of the plants necessary to wash the coal, together with the mechanical apparatus necessary to partially dry the coal, and finally the

plication of heat to complete the
ing of the coal is so costly as to
eat the purpose or nullify the
efits from the art of washing coal.
The mechanical dryers used were
two forms, those for squeezing
water from the coal, and those
removing it by whirling, or centri-
al force. The result of this treat-
nt was to reduce the coal to still
ller particles, thereby, reducing
r value commercially and expos-
increased surfaces to the absorp-
and retention of moisture. This
e the coal apparently dryer, but
eality it was not. The domestic
s, when treated in this manner,
e especially reduced in value and
ld not be permitted to be used
any coal producer on his coal
n fully aware of these facts.

the early part of the 20th cen-
, about 1915 to 1920, machines
gned and used for the purpose of
ning grains and other granular
rial, which would be injured by
ing, were applied to the cleaning
oal. This process of cleaning had
virtue of leaving the coal clean
dry and avoided the expenditure
ssary for the apparatus to dry
This dry process involved the
ng of air at high velocities
gh the mass of coal, thereby,
ng the lighter particles of coal
parate from the heavier particles
nert and semi-inert material
d with it. Hence the Art of Dry
ing of Coal was born.

chines for cleaning grains,
, peanuts, coffee, gold, sand,
were designed to work on
rials valued from $20.00 to
00 per ton and were commer-
successful at small capacities
to two tons per hour). Coal
a material of low commercial
ranging in price from ten cents
ollar and a half per ton, necessarily had to be treated in large quantities (25 to 200 tons per hour), in order to make the treatment commercially profitable. Such an increase in capacity necessitated many changes and improvements in the original dry cleaning machines just mentioned.

By 1921, the art of dry cleaning coal had been brought up to the stage where it was believed to be commercially successful and the writer presented a paper entitled "Dry Cleaning of Coal by Means of Air Tables," to the meeting of the American Iron & Steel Institute in New York, in May, 1921. Nine years later, 1930, the process, having been extended to about all the mining countries of Europe, Canada and Australia, the subject was again reviewed in a paper before the American Iron & Steel Institute, entitled, "The Present State of Development of the Pneumatic Process for Dry-Cleaning Coal," by Major Kenelem C. Appleyard, Birtley Company, Limited, Birtley, County Durham, England, and Colonel Edward O'Toole. At that date, it was acknowledged that the dry cleaning of coal had made as much progress in nine years from 1921 to 1930, as the wet cleaning had made in the previous century. This rapidity of progress in dry cleaning of coal was due to the fact that as both processes are basically gravitational and the wet process having led the way, made it much easier for the dry process to follow.

Furthermore, the dry method opened up new avenues in coal preparation that were entirely closed to the wet process, namely: the finely dividing of the coal for the purpose of releasing the small inerts and semi-inerts held in the larger particles; secondly, releasing the occluded water (usually called inherent moisture) from the coal. This last being accomplished by the breaking up of particles and thereby, exposing a greater amount of surface of the coal to the action of the atmosphere. This feature in itself, has the possibilities of extending the availability of coals of a high inherent moisture content, such as Illinois coals, for metallurgical and domestic coking purposes.

In connection with coals of high inherent moisture content, such as found in the No. 6 Illinois seam for instance, we note that the various layers or seams comprising the coal measures or beds vary in thickness, hardness and purity. As a matter of fact, the purest coals are the softest, break up most in handling and contain a relatively low percentage of inherent moisture. Consequently, the small or fine coal contains a large proportion of high quality coal, and therefore, easily adaptable to the Dry Cleaning Process. If properly cleaned, this small size Illinois coal can be made economically into coke or briquetted, whichever method is more remunerative.

The surface moisture which the coal has picked up in the mining is also separated and partially carried off by the air used in the dry process.

To accomplish this purpose thoroughly, if not perfectly, the separation of fine coals from fine inerts in a dry state necessitated the designing, developing, and incorporating many new features in the Coal Separation Machine.

The wide range in size and composition of the mass of coal to be treated complicated the situation. The range in the size of the coal particles has been increased from the size of various grains, beans, peanuts, etc., to particles ranging in sizes from 4″ to 0″, and a range in tonnage from 25 to 200 tons per hour, depending on the size of coal being cleaned. Raw coal ranging in size from ¾″ to 0″ may be fed to the latest type dry separator at the rate of 75 tons per hour and the separator will deliver this 75 tons per hour in the following sizes: 1st, minus 48 mesh coal; 2nd, 48 mesh to ¾″ coal; 3rd, ¾″ to 48 mesh refuse.

The first size, 48 mesh to 0″ coal will not be cleaned, but will contain about the same amount of dirt the Raw Coal contained. The second size, 48 mesh to ¾″ coal will be cleaned possibly to 1.5% of the agreed inherent ash, and the third size, 48 mesh to ¾″ refuse will be cleaned to approximately 1% of its inherent ash.

The air used in the process will drive off a portion of the moisture which the raw coal contained. The inerts and partial inert separable high gravity material, consisting of slate, rock, sulphur and other high gravity material is another product. The installation and operating cost (ranging from 10c to 15c per ton) is well within the ability of the clean coal to stand.

The improvements necessary to accomplish the above results were as follows:

1. Side Discharge: The side discharging of the cleaned coal gave great range of capacity as the cleaned coal was always 85% to 95% of the material handled.

2. Return Chutes to return a portion of the coal called middlings, to the machine to be recleaned: The recleanings now amount to 35% of the whole and places the returned coal in a favorable position by mechanically stratifying the same, since the coal treated is an intermingling mass of particles varying in size, it is impossible to make a definite division of them and have two clean products,

an Coal and Clean Refuse. So it
ecessary to make a third product
ned **middlings**. It was found in-
isable to send this third product
k and mix it with the raw coal
cause it to be sized and stratified
in, on account of degradation. So
eans was proivded to return them
he cleaning table and avoid de-
lation. While in some instances
degradation of the very fine coal
f was not important, the degrada-
of the slate and other incom-
ible material contained in the
is of great importance due to
fact that it is rather difficult to
ove the very fine incombustible
erial from the coal.

. Feeding Regulator to regulate
hanically the thickness of the bed
oal on the table: It is very es-
ial that the thickness of the bed
he deck of the separator be kept
orm over its entire surface, also
orm as to the size of the particles
ning the mass of the material be-
treated, and this regulation pre-
s segregation and zoning of the
ous sized particles in the mass of
erial being treated.

. Stratifying Riffle: By means
hich the lighter coal and smaller
is caused to be placed on the
in feeding the raw coal, and the
ier and larger coal on the bot-
, which increases the efficiency
capacity of the machine. Keep-
the Surge Bin open breaks up
lgamation of wet coal, keeps the
mass granular and thereby, pro-
s separation, puts dust in sus-
ion and facilitates dedusting be-
it is settled on the deck of the
ator.

Tailing Riffle, which completes
rocess of dry separation, and in-
es the capacity of the separator.

Automatic Starting and Stop-
Device, which assures a full bed of coal on the separator at all times: Coal tipple dumping is very irregular and it is not good practice to run the separator empty or with deck partially bedded, so a device was designed to stop the separator before the surge hopper was empty and to start it when dumping was resumed.

7. The Flake and Floater Collector of incombustible, high gravity material: Most all coal contains floaters (flaky material). Some of this is coal, while some of it is composed of inert or partially inert material. Owing to the shape of this material, it has a greater tendency to float than the cubical or semi-cubical material of the same composition, and if such shaped inert small material is not carried away by the water or air, it invariably becomes mixed with the coal. We have designed a slotted dead plate with adjustable width of slots, to remove such shaped material, when it falls to the surface of the dead plate while the table is in motion.

8. The Crimped Copper Bronze Pervious Plate to rapidly move high gravity material: When coal is passed over the surface of any known substance in large quantities for any length of time, the surface of the substance becomes smooth and less effective in imparting motion to the coal resting upon it, particularly if the resistance offered to the movement of the coal particles was greater than the functional resistance of the plate surface, so a crimped plate was designed, which has overcome the difficulty.

9. Application of Heat to expand air to increase its capacity to carry moisture: When the mass of coal to be treated or being treated, contains a large quantity of water, either as a liquid or moisture, heat can be applied to the air used by the separator

as a floating medium to rarefy it sufficiently to absorb all the moisture the coal carries. The greater the amount of water present in the coal which must be removed, the greater will be the amount of heat necessary to rarefy the air sufficiently to carry it off.

Dry separating coal machines are now built in units, each unit being a complete plant and will operate on any size or kind of coal with a slight adjustment. It is built in two sizes and will have varying capacities for varying sizes and dampness of coal, ranging from 15 to 20 tons per hour when operating on minus ⅛″ wet coal to 250 tons per hour on minus 4″ coal.

To understand more clearly the relative variations in fixed carbon, volatile matter, and ash as affected by the reduction of moistures, the comparative data below is given as an illustration:

Original Sample		**Crushed Sample**	**Increase % Difference**	**% Increase**
8″ Coal		⅛″ Coal		
Moisture	10.00%	3.00%		
Volatile Matter	28.76%	31.00%	2.24%	7.78%
Fixed Carbon	54.74%	59.00%	4.26%	7.78%
Ash	6.50%	7.00%	0.50%	7.78%
Total	100.00%	100.00%	7.00%	7.78%

C. J. Sandoe: I will now turn the meeting over to the President. I want to thank all of you for your attention, and I hope we will all profit by what we have learned.

Harry Treadwell: We will now decide on the place to hold the Fall Meeting.

C. F. Hamilton: I make the motion that the place for the Fall Meeting be left in the hands of the Executive Committee.

(Motion Seconded and Carried.)

Harry Treadwell: This winds up our program on this trip, and I want to extend my thanks to each and every one of you for your kind attention. We now stand adjourned.

The following papers by C. J. Sandoe, Fred A. Miller, D. D. Wilcox, G. S. kins, I. N. Bayless, Reamy Joyce, Walton E. Rutledge, Dr. J. J. Rutledge, E. L. Berger—all members of our Institute—were presented at the 1934 ting of the American Mining Congress at Cincinnati and were published 'Coal Mine Mechanization," yearbook for 1934. We are grateful to the erican Mining Congress for their full permission to give these papers to herewith.

IR SHOOTING — AN ENTIRELY NEW PROCESS

By C. J. SANDOE

Vice President, West Virginia Coal Company of Missouri

ir shooting is a recent develop- t in the art of breaking down coal preparing it for loading. This ess utilizes as its basic principle old by-word—simplicity. It is, in itself, a self-contained unit, ile and flexible, powerful and ient, yet simple.

he word "shooting," in its true e, cannot be applied to this pro- A truer description of this air iod can be attained by using aking" to name it. Shooting is a ess which rends, tears and shat- and its effect on coal is to pre- for loading a highly fractured uct which, in this state, is readily eptible to continued breakage on essive handlings.

ie above, however, is not the case coal which has been prepared for ng by breaking down with air. new development takes ad- age of features embodied in the other than its brittleness. The n of the compressed air in the after release is similar to, if not ame, as the more widely known ox. Air, under high pressure, the lines of least resistance gh the coal, which are the natur- avage planes. The entrapped n expansion, forces the coal out nstant pressure rather than by which has a pronounced shat- effect. This leaves the coal in what might be termed its own crystalline form rather than in a highly fractured and broken condition.

A comparison might be made with the action of shooting and the action of breaking with air, to the action of a sledge and the action of a press. The sledge is comparative to shooting as the results are, in both cases, destructive, while a press, in comparison to air breaking, exerts more pressure to achieve the same results but does not have the destructive element enter its process, as it is a smooth, even pressure applied evenly and constantly. For example, a brittle piece of metal can rarely be handled with a sledge without breaking, while the same piece of metal can be easily worked-on with a press without damage to the metal itself.

The shooting, or powder-mining method of preparing coal for loading, employs the use of explosives. This method puts to use a rapidly developed, very high pressure, while with air mining, a comparatively lower pressure and larger volume of expanding air is used to accomplish the same amount of work. The blasting shock is thus replaced by an expanding or wedging action, slowly applied, but with power sufficient to provide good loading preparation. Air mining deals with pressures far above those most commonly used, but these pressures are not beyond those impractical to attain and maintain. Air mining does not involve the use of materials beyond the natural resources of any mine; air is all it needs, thus avoiding all outside difficulties.

This process has but two parts in its self-contained unit; one a compressor, the other a cartridge or bottle. The compressor used is only of such size to be capable of producing 15,000 pounds per square inch pressure. It might be said in this connection that this high pressure is not of standard usage but is rather used only for experimental purposes. Half this pressure is usually sufficient for breaking down the coal as standard practices use pressures of from 5,000 to 10,000 pounds per square inch. Another requisite of the compressor is that it must be small enough to be mobile; thus, when mounted on trucks, it can readily be moved from one working place to another in a short time.

The cartridge, or bottle, is primarily a container having sufficient size to store in the drilled hole a relatively large amount of compressed air so that it can be released at predetermined pressures. These containers vary primarily in their method of air release. One type uses a valve release and the other a shearing disc release. The first type uses gauge readings to determine release pressures and the second uses shearing strength or standardized metals to attain release pressures.

With the type of container having a valve release, the operator puts into the container only that amount of pressure which he judges is required to break down the burden given to each individual hole. The pressure for each hole is indicated on a gauge at the compressor, and after the judged pressure has been attained, the container is discharged by the opening of a release valve in the tube leading from the compressor to the container.

With the shearing disc type container, variances are made in release pressures by changing discs or replacing discs of greater or lesser shearing strength.

The cycle of operation of air mining is simple and requires but one or two men in the actual mining or breaking operation. Preparation of a face for air mining is the same as for any other type of mining. The face is undercut, or sheared, or both, as is customary. Drilling may differ only in the size hole to accommodate the larger container, or may vary in the placement of holes after successive trials with different drillings. The containers may then be tamped in the holes and left for the compressor, or the compressor can carry with it one, two or more containers to be re-used after each successive mining or breaking operation. Disc changes are made at the compressor with one type container. In the other type, the container is re-used without disconnecting from the compressor.

Time required for the compressor at the face is about 2½ minutes to a container. The compressor then moves from one place to another, speed of its movement depending on its type of locomotion.

Safety is one of the most outstanding features of this process. All transportation dangers are completely eliminated. When the machine is in motion and when the containers are handled they are in an inert state, no pressure being applied until the container is in place and the operator is at his compressor station. At the face, after being broken down or mined with air, the overburden danre minimized because of the at air mining in its expansion or air does not draw into the nd endanger any overlying roof conditions, but rather ll its work in the coal itself. ners also do not have a ten- to fly but rather roll out with l as it is broken down. Fires eir accompanying evils are also ted as there is no element g the process to produce fire. he presence of obnoxious and us gases in the place after it ared for loading is completely ted, and it can be said the air r due to forcing the air to the breaking the coal down. For s mines, in this process, there be no dangers due to the lack firing element.

he eye, air mined coal presents rent appearance. It is more blocky and has a brighter luster. The lack of fines is easy to discriminate by the eye. Also, it is to be seen that coal is not thrown from the face, as it is rare that any has traveled over the cuttings of a shortwall machine.

Costs of this process are in a greater or lesser degree theoretical and could be quoted as only those that are indicated. Actual costs at the face would not change, haulage costs would be eliminated as would be the expense of obtaining outside materials such as explosives. Indicated costs are the same and in many cases, far below those of explosive mined coal.

Thus, air mining bids fair to find a place in modern methods of coal mining and set a new standard and record for the preparation of coal for loading.

CUSSION ON AIR SHOOTING — THE ENERGY AIR-MINER

By FRED A. MILLER

Franklin County Coal Co., Inc.

air mining process just de- by Mr. Sandoe was developed rst applied at the Royalton of the Franklin County Coal nc., where mining conditions am characteristics are typical e found in most southern Illiines. Of the 3,000-ton daily y, approximately half is mined ermissible powder and loaded d, while the remaining half is ically loaded, 80 per cent of s air-mined.

pt for the addition of the Air- unit the cycle of operation in anical territory is not unlike scribed many times before and fore omitted in this discussion.

After a place is loaded out or "skinned up" it is undercut and drilled in the regular manner. The number of drill holes and their relative location in the face is a matter of experience and depends largely upon conditions and the type of loading equipment used. The empty air bottles are placed in the hole and tamped, leaving a short length of tubing protruding from the hole for connection to the compressor air line. The Air-Miner unit moves into the place to within 50 to 70 feet of the face. The compressor air line is uncoiled and connected to the bottle tubing, after which the compressor is started and air is pumped into the empty air bottle until the shearing disc is ruptured and the compressed air released. The moment the disc shears the compressor is stopped—the operator advances to the face, judges which bottle should be discharged next, connects to it, recovers the discharged bottle and carries it back to the compressor. This phase of the operation is then repeated until all bottles are discharged and coal prepared for the loader. The second man of the crew, who also acts as triprider and general helper, inserts a new disc in the discharged bottle and makes it ready for use again.

Several years of experimental work together with the subsequent application of air-mining to our mining practice has established two definite prerequisites. First, the compressor should be conveniently designed, well constructed and must be of ample capacity. Second, since the positive, sudden and complete release of a large volume of compressed air from a relatively small container is the basic principle of the process; the air-bottle must embody this principle and yet be simple and rugged in design and construction.

Other interesting and noteworthy features possessed by the process which we consider advantageous to the convenient operation of a coal mine are probably best cited by discussing the relative merits as compared to other known processes used to accomplish the same or similar results.

Since our experience is limited to explosive and air-mining methods, the comparative advantages and disadvantages which I am about to discuss are likewise drawn between these two. The disadvantages of the process are cited first.

Disadvantages

1. To begin with, a capital investment is required for equipment the exact amount of which varies. While it is not excessive, it is greater than the investment tied up in explosives at any one time.

2. The addition of an air-mining unit adds another piece of mechanical equipment to the mine and consequently means more work for the inspection and maintenance staff.

3. Upon installation this additional equipment is apt to congest the haulage system somewhat, although this feature is not serious, it is inconvenient until the personnel becomes accustomed to its movements.

4. Drilling may become more complicated because the holes required are of necessity larger in diameter than powder holes. The selection of proper drilling equipment, however, will overcome this difficulty in most cases.

And now for the advantages of the process.

Advantages

1. As pointed out by Mr. Sandoe, one of the most important features of the air-mining process is safety. In addition to eliminating the hazards accompanying the handling, storing and use of explosives, it is important to note that loose coal hanging to the face and ribs of an air-mined place is almost entirely eliminated. In the case of powder-mining we have found that the coal has been disturbed back into the solid as far as two machine cuts—not so with air-mining—air either breaks the coal loose or leaves it solid. Thus the danger of loose coal falling on machine men, drillers and other face employes is reduced to a minimum.

2. The mild action of air, as compared to explosives, gives utmost consideration to tender roof conditions.

we have made no specific tests
recision instruments to deter-
he actual difference in roof
t is significant to note the fact
-mining methods reduced roof
most to the point of elimina-
compared to powder-mining
s in the same territory.

ir-mining produces a greater
age of large size coal at the
of the finer sizes. Specific
tests have shown an average
e of 26 per cent in coal above
s and a loss of 22 percent in
low 2 inches. Further study
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d by the Carbon size
x 0"), which amounted to 21.9
in one case; while the greatest
s made in favor of coal above
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ir-mined coal is firm and sub-
less degradation in handling
owder-mined coal. First be-
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ir-mining is accomplished dur-
working shift. Where State
Laws prohibit the firing of
e shots on shift, this feature
cially attractive because the
Air-Miner is exempt from these restrictions. This makes possible the advancement of a working face more than one fall per shift, which, under Illinois law, is impossible with explosives. Hence the limiting factor on the number of falls per place in any one shift is the time required to prepare a face for the next loading cycle. Development work can therefore be greatly speeded up.

6. Air-mining allows a mechanical loading unit to be confined in fewer working places. It has been our experience that the number of working places necessary for a mechanical unit under powder-mining varies between 7 and 10. Under similar conditions we have been able to confine a unit in as few as 5 working places. This feature, while dependent on conditions, does offer possible savings in material by more concentrated workings.

7. As a general rule there is less digging for the loader to do in an air-mined place than in a powder-mined place. In our attempt to obtain the best grade of coal possible with powder-mining we have experienced difficulty in loading because of the tendency of the coal to merely drop down in the space formerly occupied by the kerf. While this coal is thoroughly and completely shattered, it remains in a more or less standing condition and is sometimes hard to load, and we are all familiar with the disastrous effects to equipment while trying to load tight coal. Air, on the other hand, not only breaks the coal from the face and ribs, but also pushes it from the face in a loose, blocky pile.

8. In air-mining, tamping material consists of moist drill cuttings; there is no ash-bearing material added to the coal pile as in the case of explo-

sives, where incombustible stemming is recommended.

9. Air-mining is not a labor-saving process. The greater part of the money ordinarily spent for explosives is spent on labor and that money in turn is placed in circulation in your own community. Where division of time is necessary because of surplus labor this fact has a decided bearing on the attitude of the personnel and the introduction of air-mining equipment is viewed with much less disfavor than the introduction of some other mechanical equipment.

10. Air-mining is economical. We fully realize the utter impossibility of comparing costs unless we talk of the same items and all sets of figures are reduced to a common basis. The charges which constitute our operating costs for the same work under both methods are composed of the following items:

Items	Powder-Mining	Air-Mining
Operating Labor—		
Drill Labor	X	X
Shotfiring	X	
Handling Powder	X	
Compressor Labor		X
Operating Supplies—		
Blasting Supplies	X	
Air-Miner Supplies		X
Repair Labor—		
Drills	X	X
Compressor		X
Bottles		X
Repair Supplies—		
Drills	X	X
Compressor		X
Bottles		X

Total Operating Cost

Under Operating Labor, drilling in both cases is the same. Shotfiring labor and labor required for delivering powder is chargeable only to powder-mining, while compressor labor is an item of air-mining only.

Operating Supplies in the case of powder-mining consists of powder, caps, fuse, drill bits and sundry items such as tamping bags and tools.

In air-mining this same charge covers discs, tubing, drill bits and similar sundry items.

Repair Labor and Repair Supplies to drills cover the same items under both processes, while Repair Labor and Repair Supplies to compressor and bottles are items of air-mining.

No mention is made of the cost of investment in either case, since this may be handled in a number of different manners. We do feel, however, that capital investment in the case of air-mining should not be spread over a period of more than 5 years.

Without assigning or attempting to assign a monetary value to any of the advantages or disadvantages of either method and by pitting like charges against like charges, the economy of air-mining is evidenced by the fact that our Air-Miner operating costs are not only comparable to our powder-mining costs, but in more recent instances have even bettered them.

When we consider that these costs and conclusions are compiled from operating data obtained by use of the first two compressor units ever built is service and knowing that air- g costs are largely dependent on essor capacity, we have good to believe that improved com- r design and construction, together with natural improvements in process application, can and will substantially reduce these costs in future operations.

HE USE OF MOUNTED CUTTING MACHINES

By D. D. WILCOX

General Superintendent, Superior Coal Company

use of the undercutting nes in Illinois mines began in ous way in the Belleville District 878, although there was a er machine in use at Streator, s, for some time before that. air driven puncher as finally ved was capable of undercutting 70 tons per day. Its operation, er, was decidedly dangerous as nners were required to sit on a rm, or board as it was called, y in front of and practically the undercut coal while the and constant jar of the machine ted the runner from knowing fety conditions of his working At the time these machines first installed there was in ce, as usual, a miners' organi- , and an agreement was made he miners to set up a differ- between solid shot coal and e mined coal. During all sub- t contracts this differential has ed constant regardless of the vement of the cutting machine, in less labor, safety or greater tion. It is evident that this ential was in effect an allow- y the miner for the use of the cutter and the purchase and pment of improved types of machine had to be paid for f this differential and the age to the owner, if any, had e out of the increased saving in upkeep that the newer machine would make. The fact that the newer machine could cut more coal was of no benefit to anyone but the miner, as it merely meant that there were fewer men with whom to divide the tonnage rate.

The Illinois mines became greater in extent and the loss of power due to the great distance that the compressed air had to be transported, and the constantly increasing cost of maintaining the puncher machines furnished the principal reason for the establishment of the electric breast machines, although at that time there were a few air driven breast machines in service. The breast machine was a success from the very start and has continued to be an efficient machine, in fact, its success led to the development of the Shortwall machine. But the advent of the Shortwall was another story to the owner of the mine. It had all of the properties of an improvement, but the entire advantage of its installation was absorbed by the miner. In most cases the work for the miner was easier and safer, and the machine could cut twice as much coal, but the coal operator was merely out of pocket for his improvement. Some owners went back to the use of breast machines, and it began to appear as though the development of undercutting machinery in Illinois mines had come to a standstill due principally to the unchangeable differential in the labor contract with the miners. A high wage scale, coupled with a forced lack of progress began to force Illinois coal out of the competitive coal market and consequently in September of 1928 a contract was entered into which permitted the operation of cutting machines on a day wage basis. This idea opened the door for the use of the mounted cutting machine of which there are now 66 in service in Illinois mines.

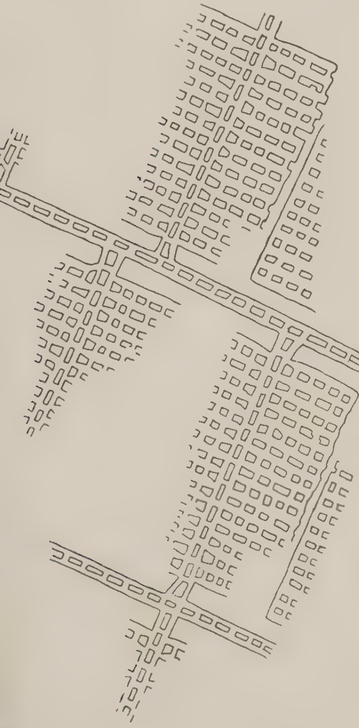
The mounted machine, which weighs about seven and one-half tons, operates directly from the track. The machines are equipped with two motors, one of 50 horsepower for cutting and one of 10 horsepower for tramming and sumping. The weight of the machine is sufficient to sump the cutter arm without using jack pipes or chains, although jack pipes are used in making the cut to keep the machine from slewing the track. Care must be taken in sumping so that that machine will not jump back when the cutter chain meets unusual impurities. This is caused by dull bits or feeding the cutter too fast. The operation of the machine is so rapid that it is necessary for one man to remain constantly at the controls. This speed also prevents the helper from keeping all of the cuttings out of the kerf when cutting on the bottom. The machines are equipped so they may be reversed to remove the cuttings, but unless care is used they carry in as much cuttings in this process as they remove.

The cutter bars used are eight feet in length compared to six feet on a shortwall, and fully extended they cut a place 30 feet wide leaving a straight rib and a rounded kerf. Of course a place can be cut as much less than thirty feet as desired and still maintain a straight rib. Our machine men have marked the revolving frame on which the cutter rests so that the width of the place is accurately measured and cut. It requires less skill to cut a straight rib with a mounted cutter than with a shortwall. The cables, which are wound on automatic reels, are rubber covered Duplex No. 2, three hundred feet long, wiring being carried for a distance into each room. The machines are equipped with trolley poles which add to the tramming speed, and as the cutting is done on the hoisting shift it is sometimes necessary for the cutting machine to switch either loads or empties out of the way to allow the cutter to proceed.

The Superior Coal Company, a subsidiary of the Chicago & North Western Railway Company, owns four mines in Macoupin County, near Gillespie, Illinois, and at this time three of the mines are being operated and are working in No. 6 Illinois seam. The operations began in 1903 and all of the coal mined (approximately 75,000,000 tons) has been undercut with the exception, of course, of short pieces of development work. The undercutting was done first by puncher machines, then by electric breasts and shortwalls, and at this time all of the coal is being mined by mounted cutting machines at the three operating mines.

The system of work is a modified panel system, and about sixty places are allotted to each cutting machine, the distance between the two extremes of a machine territory at times being as much as a mile. The coal is all loaded by means of two men pit car loaders, 27 of these being assigned to each machine and the coal is gathered by three gathering motors on each unit. The power is 250 volts

. and the wiring is 4/0 except
2/0 is used for short distances.
rooms are driven 30 feet wide,
300 feet deep, the entries and
cuts being 21 feet wide; the
ine doing its own development
. The track is 42 inch gauge,
20 pound iron with either square
len ties or steel ties spaced 2
apart. The track switches are
into each new place before cut-
The first cut in each place is

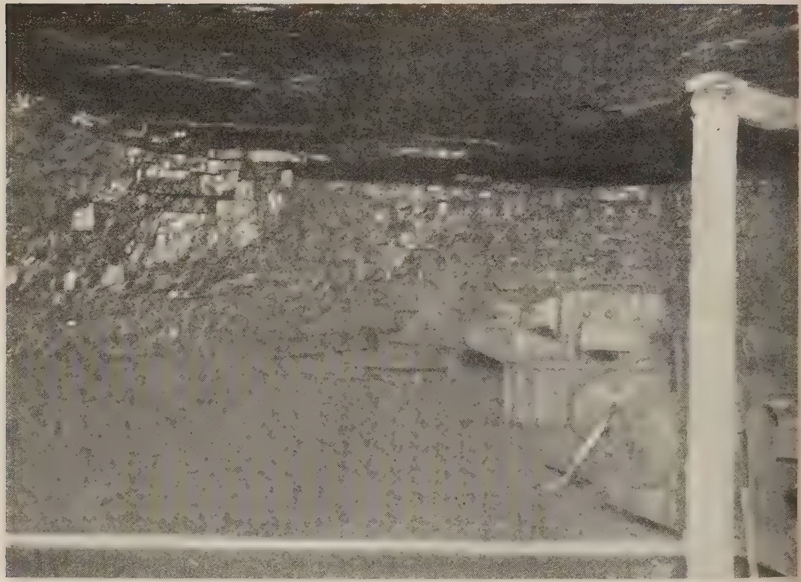


tory of a Mounted Cutting Machine.

full cut. In fact in room
and cross cuts it is the third
fore full tonnage can be ex-
. The shooting is done once
day and permissible explosives
sed. The territory is built
around the cutting machine and one foreman is in charge of each territory.

There has been a constant attempt to balance the work done by each part of the operation so that it fits in properly with the other parts and consequently none of our mounted cutting machines are pushed to capacity as that would entail extra haulage or extra drilling, or extra loading and in the end a higher cost per ton. Our figures then are not of machine capacity but of actual operation.

Since the purchase of the first mounted cutting machine on April 2, 1929, twelve additional machines have been purchased and have undercut more than six million tons of coal. At this time there are four of these machines operating eight (seven) hours per day at each of the three operating mines of this company, and they undercut all of the coal produced. These machines were installed gradually as in some cases it was necessary to make haulage or power line changes, and all of the mines were not fully equipped until January 1, 1931, at which time Mine No. 3 was completely changed. Our principal reason for making this change so abruptly was in order to get comparable operating costs. The cost figures used in this paper are those developed from this mine, the production of which for the year 1933 was 662,749 tons for daily average of 3,413 tons, all of which was cut by four machines never working more than eight hours in one day, and at no time being out of service long enough to impair the output. The best day's cutting was approximately 1,200 tons, but from our records the number of tons cut per day by the different type of machines is as follows:



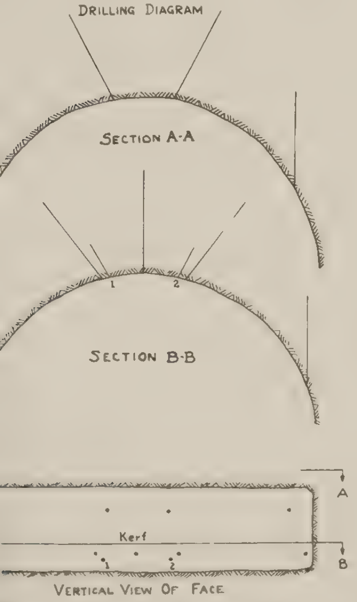
Place Being Cut by the Mounted Machine.

Puncher machines -- 70 tons per day
Breast machines ---170 tons per day
Shortwall machines -300 tons per day
Mounted cutters ---900 tons per day

When the first mounted cutting machines were installed their production was about 500 or 600 tons per day, and the cutting was done at or near the bottom of the seam where the previous types of machines had mined. It was necessary to lower the cutter bar to begin cutting and raise it when the cut was completed. The cuttings were not all removed from the kerf and a cutter bar was sprung because the runner of the machine could not see the stress in time. Also the same impurities usually found at the bottom of the seam had to be encountered. As all of the cuttings were loaded out it was finally deemed advisable to cut in an extra clean band of coal about thirty inches up from the bottom. This was made possible by putting a shim under the cutting mechanism of the machine. The time of cutting was reduced and now each wide place is cut in from twelve to fifteen minutes.

The change brought up several new problems. While it produced a better grade of fine coal, used less power, cut 50 per cent more coal, left a kerf free from cuttings, and required less repairs, it also cost more for explosives, left a poor floor to shovel from and the drilling and shooting had to be altered. The attached sketch of our present method of drilling shows seven holes drilled in the bottom and four in the top coal or a total of eleven holes in each wide place. Three set ups of the electric drill are required for the drilling as five bottom holes and two

noles are drilled from the center
ion. Nine foot augers are used
the conveyor type of auger which
s the drill cuttings out of the
, is now being installed. Fuse is
and holes (1) and (2) are shot
It was believed that the
ded kerf would be difficult to
t. As a matter of fact the
ded face is an aid in shooting.
place cut by a shortwall the
r either has to square up the
ers or use excessive explosives to
it loose. Seventeen sticks of 1
three-quarter inch by six per-
ble explosives are used to shoot
each thirty foot place, which is



ing Our Present Method of Drilling.

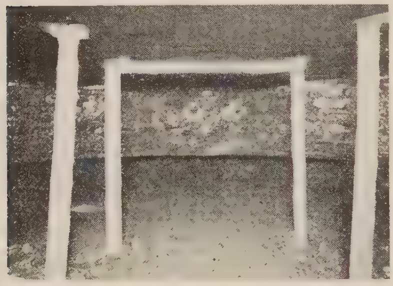
er cent more than is required
cut by shortwalls, but it is be-
that a cut eight feet deep in a
seven feet high and thirty feet
would be even more difficult
it not for the rounded corners

of the kerf. For loading the bottom is shot first and loaded out before shooting the top, the top being spragged before loading out the bottom. As the shooting is done but once each day and each place is shot twice, that is once for the snubbers and once for the top shots, it is evident that when a place is loaded out it is practically idle for two days. This has, at times, been a hindrance to development work. When necessary the advance work can be cut, loaded, drilled and shot in one day. This is done by putting in a double cut by the machine, the kerf then being wide enough to shoot the place without snubbing. In this case, however, the top shots are fired first.

From January 1, 1931, to March 31, 1934, Mine No. 3 of the Superior Coal Company has produced 1,809,602 tons of coal, all mined by four mounted cutting machines. For repairs, material has cost $3,083.47 and labor $1,964.72, or a total of $5,048.19, which is at the rate of $0.0028 per ton, or about one-fourth the cost of shortwall repairs, and about one-half the cost of breast machine repairs. In this amount for repairs is included $780.51 for lubrication, and $218.16 for bits, four cutter chains and five new cables, besides the cost of miscellaneous repairs. The tonnage cut by the cutter chains which were removed is as follows:

318,792 tons
207,255 tons
272,985 tons
298,561 tons

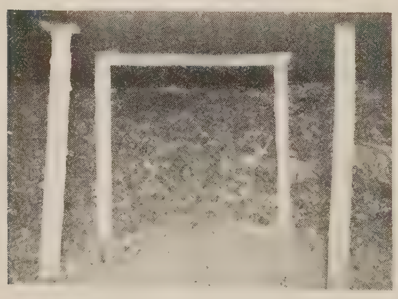
Our records of power consumed show that the mounted cutting machine cutting about 15 per cent more coal per place than the shortwall uses from 5.9 k. w. h. to 6.8 k. w. h. per working place compared to 7 k. w. h. to 8 k. w. h. for shortwall. Many of the advantages of the mounted cutter are obvious. It is not necessary to unload the machine and pull or bar it over into the corner to begin cutting. There is no sumping pan and no chains, no crow bars, no ropes, no rib hook and no skid rails, nor skid sheets. There are no tools to unload and load up. In fact, the complete list of tools is as follows:



Place After Bottom Has Been Loaded Out.

3 jack pipes
2 bit wrenches
2 lug cleaners
1 short rail
2 dutch head picks
1 shovel, and
2 oil cans,

besides, of course, the extra bits.



Place After Top Has Been Shot Down.

The mounted cutting machine, as is always the case when machines are really more efficient, is safer, it being possible to entirely eliminate face accidents to the operators. For one example of this there is the change in the handling of jack pipes, which are a prolific cause of injuries as used with the other types of machines. Eyes were injured when the machine men were picking a hole in the top to set the jack pipe upright. Then the jack pipe would fall on heads or bodies or feet. With the mounted cutters, however, the jack pipes are set to each rib horizontal and close to the bottom. It is equipped with twin headlights, one on each side of the cutting mechanism and travels across the face with it giving a plain view of the cutting face at all times. This allows the runners to speed up the machine without fear of injuring it and above all the men not only feel safer but are safer. Places may be cut thirty feet wide with the timbers within four feet of the face. Our method when timbers are close is to put the sumping cut in the center of the face and after cutting to one rib the machine is reversed to finish the place. It is not necessary to reverse the bits when this condition is met as the chain travels in the same direction at all times when cutting. Timbers along the track must be kept at least twenty inches from the rail and on turns they should be twenty-eight inches.

The success of any machine depends in a measure on the reaction of the employees toward it. The mounted cutter is built in a way that inspires confidence in its ability to do the work and it has practically removed the drudgery from the job of undercutting coal.

CHANICAL LOADING AT THE CONSOLIDATED COAL COMPANY OF ST. LOUIS

By G. S. JENKINS
Mechanical Engineer, Consolidated Coal Company of St. Louis

bout the only thing we have in
mon with Mr. Knox is the
uct. Operations of the Con-
ated Coal Company are limited
he State of Illinois and No. 6
1 which dips about a percent or
to the north. While we do not
handicaps of a pitching seam
lo have gas and water to a con-
able degree. Of the coal pro-
d by members of the Illinois
Operators Association in 1933,
t 27,000,000 tons, only 22.4%
mined by hand; 24.2% by con-
rs; 34.3% by loading machines;
19.1% by strip pits.

ne mechanization program of the
pany began about 1926 with the
nt of the pit car loader. We
ggled along with that program for
uple of years and in 1928 de-
1 to try out the Mobile type load-
machine. We tried out several
s and standardized on the Joy
ling Machines. At present we
26 of these machines. Our
erties had been undercutting the
since the development of the
ng machine, so that phase had
dy been worked out.

ith the installation of the Mobile
loading machine, we found our-
s beset with several difficulties.
r hand-loading and conveyor-
ng we had been taking the Coal
fire clay floor. With the load-
nachine we found we had to
3 or 4 inches of Coal floor to
ate machine operations and to
nt loading of fire clay with the

s meant a re-education of the
cutting machine men. Since
the loading machine could not differentiate between Coal and impurities we had to erect adequate surface preparation facilities. The problem of gathering presented itself with capacity production. Mules were discarded and locomotives installed 100%.

We standardized on storage battery gathering locomotives on account of the flexibility and power demand and our experience still keeps us of the same opinion.

We operate the Joys in units of two, having one Joy on each side of a pair of entries as a general rule. An assistant mine manager is in charge of two units consisting of the two loading machines, two under cutting machines, two drills and three locomotives. One locomotive serves each Joy and the third one operates as a relay motor between the main line parting and the service motors. This relay motor is storage battery operated, but a real locomotive could always be used to advantage in territories with excessive grades when an adequate power supply is available. However, in Southern Illinois where we experience our worst grades we have no difficulty with storage battery motors. Our relay motors in this territory weigh slightly over nine tons complete with batteries and our service locomotives slightly over seven tons complete with batteries.

Storage batteries keep down the power demand and allow charging on the off-peak period. Our experience indicates that the power demand saving, pays for the batteries, and we get the flexibility of operation at no extra cost. Each two units are supplied with power by a motor generator set—installed at the territory—this insures adequate power and minimum voltage drop.

Coal is handled to the bottom with 15 ton trolley locomotives on a dispatch system, a trip of 30 cars reaching the bottom every 10 minutes. These locomotives make about 240 car miles each hour. The haul being 2% grade against the loads. It might be of interest to note that main line rails are now welded instead of bonded—the Constant Temp is ideal for this practice, and we have been able to secure a bond test of unity with this practice.

In getting the loading machines up to capacity, time studies indicated that the thing to do was to keep coal coming off of the rear conveyor. As we operate on the room and pillar system, this meant a series of car change experiments. We first tried putting a cross over switch through each cross cut, so that, as a locomotive pulled a car away from the Joy, a man pushed a car from this switch to the Joy. This worked out very well, except that it doubles the work of track laying and ties up too much money in rails, switches and ties.

We then tried stub switches which would hold three or four cars—the motor would back in with three or four empties and after the rear car was loaded, would pull it out and switch the loaded car into the stub, and then back the empties to the Joy and repeat this operation until only one empty was left, which would be "spotted" at the Joy while the locomotive pulled the loads off of the stub, on to the entry and came back in with more empties, and would repeat the above cycle.

The pushing of cars around curves especially in the presence of grades, caused considerable derailment—this was overcome by driving the room on a 60 degree angle to the entry instead of 90 degree and easing off the curves, so that now a motor can push a trip around the curves at full speed without derailments.

The above method provided a good car change at a reasonable expense but did not cut down the long moves, so we next tried the "checkerboard" system, modifying it to meet our top conditions and maximum allowable extraction.

On the checkerboard we get two falls in each room, i. e., the face and the cross cut. The face and cross cut are undercut without reloading the shortwall cutting machine so time is saved on that operation. On this system, the face and cross cut are cut for three cuts, and then the face and a cross cut on the other side are cut for three cuts and the cycle repeated, thus the far rib of the cross cut to the left is opposite the near rib of the cross cut to the right and vice versa. By throwing the center lines of cross cuts of adjacent rooms out of line we reduced the area of the breakthrough which tended to some degree to strengthen the top. As to the desirable room length we tried up to 600 feet, but standardized on 350 feet.

Before using the checkerboard we were in the habit of leaving 18 inches of top coal. We are now leaving the top coal in the first half of every third room. When this room is in 175 feet switches are turned left and right and the rooms on either side picked up from this coal top haulage room. The remainder of the haulage room is shot to slate like the rest of the rooms. The track is then recovered from the first 175 feet of the rooms on either side and used in the advance. The timbers are like-

recovered and used on the
nce and the slate allowed to fall.
cuts down on the quantity of
rial in active service, and also
down on material delivery as it
ithin 175 feet of where it will
sed.

addition to the above the load-
nachine goes into a room for two
of coal. Conditions have led
adopt 24 feet as the ideal room
n in the Southern Illinois field.
l conditions, of course, at times
re narrowing down and on the
time permit widening out. The
eet width being the base line.
ous room centers have been tried
51.96 (60′ x sine 60°) adopted
andard. It might be of interest
ote that the timber and track
rial cost on a per ton basis has
cut almost in half on this
m.

to the method of loading cars—
Joy starts into the face which
been shot down and loads out
tly ahead of the track. This
of course is necesarily loaded
the end of the car and only one
loaded at a time. When this
r has been loaded out, slide rails
out down to the face. The Joy
loads out of the face on the
site side from the cross cut—
or three empty cars are backed
d the Joy loads them over the
When the car nearest the motor
aded the trip is pulled up and
econd car loaded, and if three
es were brought in it is treated
like manner. The locomotive
pulls out and replaces the loads
empties, thus changing the cars
os and threes. While the loco-
e is out changing the cars the
g machine does its digging and
rges the coal across the track
r a pile of loose coal. When the cars are back the machine loads into them.

Then when this side is skinned up the machine is moved into the cross cut and loads the cars over the side. During car changes the boom is swung over onto the pile and loaded from the other side. When the break through is skinned up the machine then re-loads from the pile of loose coal and then loads out the face. Local top conditions require that timbering methods be worked out along with this method to facilitate loading, also loading methods at times have to be modified to suit the top conditions.

The Face Bosses all have their papers as Mine Managers First Class and we believe them competent to modify the methods as safety and local conditions demand.

The above system where it can be applied, has worked out to be the most efficient one with us. Under this system shortwall under cutting machines are used, one for each Joy. While a track cutting machine would cut for two Joys at a saving of two under-cutting machines, it would require two additional track layers to lay the additional track and switches, and this along with the additional track material would more than offset the saving. So it is evident that this system is not adaptable to track cutting machines, but gives a result in cost to offset the gains of a track cutting machine by using machinery already available. Should a suitable caterpillar mounted cutting machine be developed it, of course, would be the desirable equipment under this system.

As you of course know, on-shift shooting is prohibited in the state of Illinois, and this of necessity requires the carrying of sufficient places on a section to insure ample coal for the following day. We have found that 8 to 12 rooms is about the ideal number—less than that incurs the risk of running out of shot coal should a break down on cutting machines occur. More than that incurs a cost that is useless, both in the material tied up and the labor required to keep them in shape.

At the present time we are doing some experimenting with air shooting which is permitted "on-shift" and should enable us to cut down the number of places to be carried on a section.

The above has all been relative to individual sections. One of the main things to keep in mind in mechanization is concentration of equipment. We have found that concentrating the machines in adjacent panels affords us an opportunity to adequately service them and at the same time cut off the maintenance of miles of territory. Supervision is easier and delivery of material less expensive. Also a section of the mine can be quickly worked out and abandoned.

CAPACITY OF MINE CARS AND THEIR RELATION TO SUCCESSFUL MECHANICAL LOADING

By I. N. BAYLESS
Assistant General Manager, The Union Pacific Coal Company

Coal mines were opened in Wyoming along the Union Pacific Railroad during the year 1868. Data and pictures show the mine car used at that time as a box on wheels. This box carried approximately 1,000 pounds of coal. From this time until about the year 1900, the drawings of the mine cars used indicate a desire on the part of the management to increase the amount of coal carried in the bed of the car. This development first manifested itself when the sides of the rectangular box about eight inches above the floor were flared from this point to the top of the car, next this flare was changed and one vertical side board was added at the top, the overall width remaining the same. The process of lowering the flare boards and adding additional vertical side boards at the top continued until about the year 1900 when the flare board was lowered until it just cleared the car wheels. The surprising thing about these cars is the number of years during which the inside length of the car body remained between six and eight feet, the preponderance of animal haulage in use during the period no doubt contributing to this result. The first cars of this type for thirty inch gauge mine track held only about 2,000 pounds of coal, bed full. By the year 1905 cars of this type for forty-two inch gauge track would hold 3,500 pounds bed full. This type of car, with few exceptions, was continued in service until mechanical loading devices became recognized coal equipment, in fact, there is a surprising number of this type of car still in service.

The opening of new mines in the vicinity of old mines, which were soon to be abandoned, resulted in perpetuating the existence of more or less antiquated mining methods and the continued use of very narrow gauge track and obsolete equipment from the abandoned mine. It was

the practice to build mine cars
the mine. Large quantities of
car material such as car bands,
ls and axles, lumber cut to
h, and other material was
lly available which it would be
ght advisable to utilize.

ring the period mentioned
e, car wheels and axles had
ually been made heavier and by
ear 1900 a marked improvement
been made in the design of car
ls, axles and bearings. New
ls of the plain roller bearing type
being tried out at different
tions with varied degrees of
ss. It had become standard
ice at these mines to assume
the wheel base on mine cars
d not exceed twenty-eight to
inches and it is surprising how
of us were led to the belief
a car with greater wheel base
not be successfully operated in
mines. The coal mined in this
ory is obtained from coal seams
a maximum of 25° from the
ontal, the early mines using
rails—twelve to sixteen pounds
yard—and short stub switches
common practice. For many
empty cars on the less inclined
s (up to 10°) were delivered to
orking faces by mules or horses,
oaded cars being switched from
vorking face by the men who
d the coal. On the steeper
s (10° to 25°) various systems
as McGinty's or chutes were

e to the topography of the
ry and the fact that the coal
in pitching seams, it is not
o find desirable locations for
g new mines where the
ary room for railroad tracks
op works would be available.
se of this condition haulage
in these mines were eventually
driven long distances, in some cases, four to five miles, which resulted in an acute haulage problem with the small cars in use. To overcome the problem of car shortage on account of the long haul it became common practice for the hand loaders to build up, or what is usually termed chunk the car, until in many cases the coal carried above the car body equalled the amount in the body itself. This practice continued over a period of years, the managements thinking of the car as a forty hundredweight car, or two tons, and because of this practice it became the custom to compare the deadweight of the car handled per ton of coal hauled on the above basis.

After the installation of the first mechanical loading devices, an attempt was made to chunk, or build up the car, until it would carry approximately the same amount of coal as when loaded by hand methods. Managements very quickly decided this was not practicable as the machinery remained idle while the coal was built up on the car by hand, and when an attempt was made to chunk the car while the machinery was in operation, men's hands and arms were injured. The attempt to build up the coal above the car body was quickly abandoned with the result the car only carried two thousand pounds, or one ton of coal, making it necessary to handle approximately one hundred per cent more cars to and from the mechanical loader and more time was spent in switching than in loading the cars. This fact being established, engineers were placed on the job to make time studies of the different operations. Haulage was speeded up which resulted in an increased cost for haulage and maintenance. The time studies suggested the installation of large capacity mine cars as the one practical solution. This solution involved radical changes in these mines due to the fact that practically all of the operations were in old territory where close timbered, narrow entries with insufficient head room had been driven. Operations through these entries were carried on for many years on a thirty to thirty-six inch track gauge and over light rails, except on the slope and main haulage roads, where a heavier rail was used.

Under the conditions existing in many mines, the capacity of the car could only be increased by adding length to the car. The length that could be added was limited because of curves, switches and insufficient clearance. The studies disclosed that the cost of widening the track gauge in many of the old mines would be prohibitive and in such cases a new design of car was made for the existing track gauge with as large capacity as could economically be moved through existing haulage roads. In some mines a board six to eight inches high was added to the cars in use whenever the freight of roof would permit. All new haulage ways in these mines were driven with sufficient clearance to operate larger cars at a future date.

New systems of mining were studied, and different types of mechanical machinery for loading coal were examined to determine the machines best suited for the mining conditions. On seams inclined up to 15°, scraper loaders discharging on transporting conveyors have been installed, and shaking conveyors are being used successfully on pitches up to 22°. These installations allow for the establishment of a stationary loading point where trips of cars coupled together can be run under the chute and loaded, thereby eliminating a large part of the time necessary in switching individual cars.

Since mechanical loading of coal has assumed such proportions and it has been proven not practical to load cars mechanically much above the car body, we have been compelled to revise our set-up of dead-weight per ton of coal hauled in the design of modern cars and it would seem only a matter of time until mine cars will be constructed of lighter weight materials to partially offset the dead-weight ratio.

The capacity of mine cars is an important factor governing the production loading rate of a loading machine. Time studies show that the greatest loss in time with mobile type loaders is due to car changes. With larger cars, more tonnage can be loaded with fewer changes for the same tonnage and with less production loss.

The following table shows the relation of, first, car size; second, tons loaded per hour, and third, per cent of cycle time loading.

Time Loading (Minutes)	1.33	1.63	2.00	2.48	3.11	4.00	5.33
Time Changing (Minutes)	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Loading Cycle (Minutes)	2.67	2.96	3.33	3.81	4.44	5.33	6.67
Tons Loaded Per Hour	22.50	24.75	27.00	29.25	31.50	33.75	36.00
Cycle Loading	50%	55%	60%	65%	70%	75%	80%

Where the cars can be run under a fixed loading head and a trip loaded without uncoupling or switching the cars, the loss of time in changing cars is so reduced that the size of the car is not such a vital item. Using the above table, assuming the capacity

of the loader to be the same,
45 tons per hour, and the time
ging of one car to be ¼ of a
te, the percentage of loading
ranges from 84.4% for the one
ar to 95.5% for the four ton
ity car, a span of only 11.1%
ared with 30% for the mobile
r. While production is greatly
ased it is more due to the fact
he cars can be kept continuously
the fixed loader head, thereby
asing the percentage of the
loading time, rather than the
ve capacities of the mine cars.
ver, the capacity of the car is
ry important factor in the
ge. Assuming that a motor
two ten car trips per hour, the
production is in direct propor-
to the size of the car and the
ased haulage cost is roughly in
nverse proportion. With the
capacity car there is less like-
of delays to the loader waiting
mpties due to the increased time
ding the trips.

mining men realize each mine
ts individual problems, and in
lering the capacity of mine
for any given operation consid-
n must be given to the height
he seam, tonnage required,
s, distances, track gauge, kind
tive power, whether working old
territory or developing new
, weight of rails, clearance, roof
ions, kind of loading equip-

imal haulage has for the most
been displaced by electric
ge and the continued improve-
which is being made on mine
heels tends to make transporta-
f the cars much easier. The
ody cars which are handled by
dumping devices has im-
the method of handling coal
tipples.

The installation of large mine cars will require better haulage roads, although good, well maintained haulage roads are desirable for any size equipment. The maintenance cost of haulage roads should be decreased if first-class tracks and rollers are in use, the wear and tear lessened on equipment such as hoists, motors, mine cars, etc. Less time will be required for changing cars, there will be fewer derailments, which, with the small cars caused considerable loss of time in rerailments. The increased safety of this improvement should not be lost sight of as the hazard from derailments is of no small consequence.

There will be less tendency to overload the cars, and consequently less spill over the sides of the car. In this connection, the steel or composite cars are better suited for mechanical loading for the reason they allow less leakage which will reduce the cost of cleaning haulage roads. In designing a car, a careful study should be made of the physical conditions of the individual mine. Within practical limits, the height of the coal seam will determine the height of the car; the character of the roof will determine the width of the haulage way and the gauge of the track, this width and gauge being the limiting factors in the width of the car; length and wheel base must be governed by the radius of the curves over which the cars must travel. With these factors known it will be possible to develop the maximum capacity car that can practically and profitably be used.

The success of mechanical loading is in keeping the loading machines operating to capacity, and in order to do this it is necessary that sufficient cars be supplied at the point of loading and that these cars be available for loading from the beginning of the shift to the end.

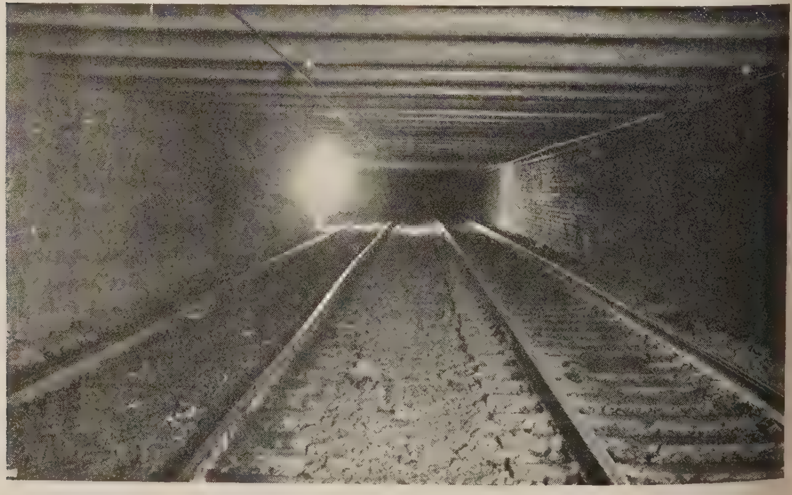
Properly taken time studies will develop wherein the haulage is defective in securing the maximum loading time possible at the loading face. When the haulage and loading time have been co-ordinated, the use of large capacity mine cars should result in increased morale among the employes since waiting for cars when the loading unit is in position to load coal decreases the competitive spirit which is an important factor when loading coal mechanically and especially where a tonnage rate is paid or where a combination tonnage and day wage is paid.

In the writer's opinion large capacity mine cars are essential to successful mechanical loading and therefore, the car with the greatest capacity possible which is practical for the conditions under which it must operate should be installed.

METHODS OF PERMANENT ROOF SUPPORT

By REAMY JOYCE
Chairman, Subcommittee on Roof Support, Coal Division,
American Mining Congress

The research committee on permanent roof support has an interesting and important assignment. While its work is not as spectacular as research in problems of ventilation and the prevention of explosions, it nevertheless ranks high in safety work and in the difficult job of developing a profit as the result of mining operations. The necessity of maintaining adequate roof support in main headings is fundamental. That method of construction is ideal which results in safe, uninterrupted opera-



Steel I Beams Supported on Brick Pilasters, Protected by Brick Curtain Walls, Clyde No. 1 Mine, W. J. Rainey, Inc.

at low cost. The first cost of
uction and the annual cost
must be absorbed during the
f the mine are matters of judg-

n Heading, Consolidation Coal Co.,
Mine No. 3

based on experience, knowledge
esearch.

the construction materials or-
ly used for roof support—wood,
ry, concrete, steel, and com-
ons of these materials, each has
n advantages, as well as certain
tions. All of these materials
known working stresses and
designs can be made for any
with certainty. The nature of
of to be supported, the quantity of coal to be mined, the probable life of the headings, must be carefully studied when the plan of operation is laid out. Serious consideration of the types of roof support to be used to meet the widely varying conditions, not only in different coal measures but in the different parts of the same mine, is vital and necessary. No one type of construction can be expected to produce the lowest annual cost combined with adequate safety for all operating conditions. It is therefore necessary to study the properties and characteristics of different construction materials and to forecast the results of their use under definite conditions of service.

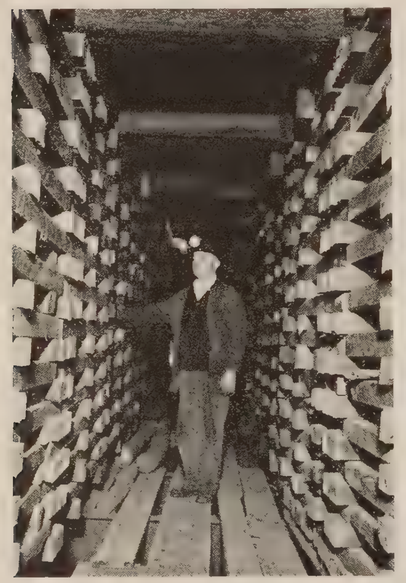
Rails in Commodore No. 2 Slope,
eld Bituminous Coal Corp., Prevent
Damage to Slope Timbers.

Wood

Wood timbers have the advantage of low first cost. Wood timbers, when sound and free from decay, possess great strength for their weight. Unfortunately, naturally durable wood is scarce.

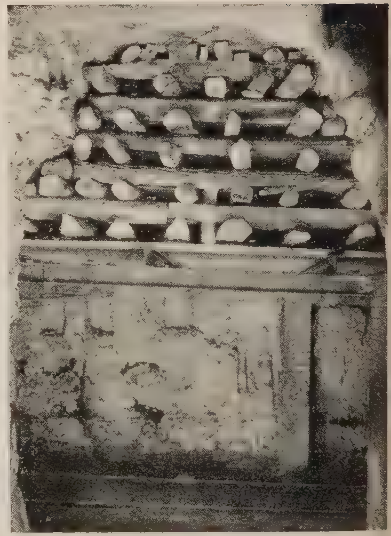
The two woods which grow in the United States that have both great structural strength and natural durability are Bois d'Arc and black locust. To the extent that these woods may still be procured at a reasonable cost, they make ideal mine timbers.

The average woods run oak timber that is now available for mine use is not resistent to decay in the natural state; the original strength is soon lost and the presence of rotten timber in the mine constitutes a fire hazard. The other hardwoods possess even less natural durability than the oaks, and the same is generally true of the pines and various other conifers. Most of these woods, however, possess adequate strength when sound, and failure from decay may be eliminated by chemical impregnation under pressure-vacuum processes. Certain chemicals, like zinc chloride, which prevent decay, also have valuable fire retardant qualities. Chemical impregnation, using modern methods, does not change the physical properties or strength of the kind of wood treated. A very slight increase in size in the less strong woods compensates for lower working strength. For example, a round stick of timber increases in bending strength as the cube of its diameter and in stiffness as the fourth power of its diameter.



Treated Timber Cribbing, Bell & Zoller Coal & Mining Co.

Wood is resilient and has far greater ability to absorb impact than any other material. It bends before it breaks, and the sound which may be heard and the deformation which is seen as wood takes a load are useful in gauging earth pressures. When broken through wrecks or squeezes, wood timbers are easily removed, which is not so true of masonry, concrete, and steel, which often have to be shot or cut out.



Cribbing on Steel Supports.

It is therefore important to think of wood as being in three distinct classes:

Untreated timber: 1. Naturally durable; strong; scarce. 2. Not

Switch on First Right Heading, Consolidation Coal Co., Mine No. 3

lly durable; strong when sound; ful.

mically treated timber: 1. Durstrong; plentiful.

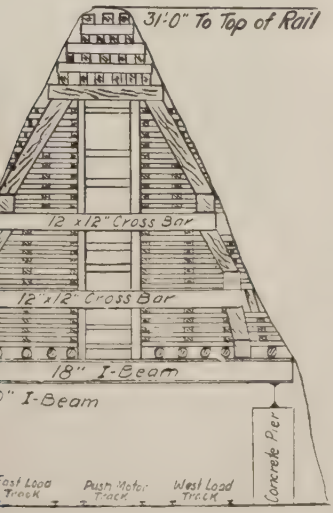
od timbers have a further tage in that they may be "red" and reused if sound. This icularly true of treated timber a lesser extent of steel timbers. ry and concrete are so fixed in they cannot be moved.

Masonry

k walls, arches and pilasters rable, incombustible, and most ctory when properly built to he right conditions of service. st cost is high and skilled labor ired for this type of construc-Maintenance cost is practically not disturbed by wrecks or novements.

Concrete

e concrete does not require me skilled labor that masonry s use entails much more careervision and engineering skill.



f Timbering at Zeigler No. 1 Mine, Zoller Coal & Mining Co.

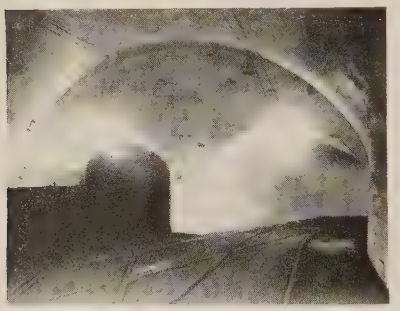
There are certain roof conditions that may be made stable by the application of from one-half inch to one inch of gunite when the roof is first exposed and before any appreciable amount of air slacking has started. Concrete may thus be used in various headings where a thin coat will be effective up to the heaviest types of reinforced concrete construction. Main slopes, main drifts, main bottoms, and other "bottle necks" are often sufficiently important to justify the heaviest type of construction because of the difficulty of maintaining unstable roof conditions. First cost of the type of construction selected must be balanced with the safe maintenance and dependable operation of these strategic headings.

Steel Cross Bars on Brick Piers

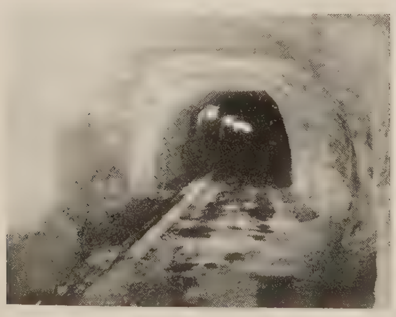
Bad concrete disintegrates and the water in some mines seems to have this effect even on good concrete. The importance of intelligent supervision of concrete work cannot be overestimated.

Steel

Steel I beams, H beams and steel rails are successfully used as headers or crossbars for permanent roof support rather widely by coal mines. They are valuable in securing maximum head room. While the first cost of steel timber is greater than wood, the labor cost of installation is generally less. In some places, corrosion of steel timbers is a real problem, and painting is often difficult if not impossible. Steel must be cut to length before being taken into the mine. Any necessity for further sizing must therefore be taken care of by the shape of the heading where it is installed. To a lesser extent, steel legs are used to make three-piece timber sets, but usually wood, either untreated or treated, brick, concrete, or the coal itself is used to support the steel headers.



Main Bottom—Concrete Arch Nemacolin Mine, The Buckeye Coal Co.



North Manway After Guniting, Nemacolin Mine.

Aims of the Committee

It is the duty of management to return satisfactory earnings on invested capital. Undermaintenance is expensive and often unsafe. Overmaintenance or methods requiring unnecessary capital investments are also expensive and may make the profitable operation of the mine impossible.

The challenge of operation to management requires alert thinking. Conditions are changing. Labor costs are up. Methods and materials must be studied as never before. Coal mining now has a real opportunity to demonstrate its ability and stamina.

Steel Arch Roof Supports, Nemacolin Mine, The Buckeye Coal Co.

The committee on permanent roof support hopes to present to the American Mining Congress many good methods of roof support, together with the first cost of construction, the maintenance costs, the service conditions, the service life, and finally, the annual costs developed by the various materials and methods.

NEW COAL PROCESSING PLANT OF THE BINKLEY COAL CO.

By W. E. RUTLEDGE
Vice President, Binkley Coal Company

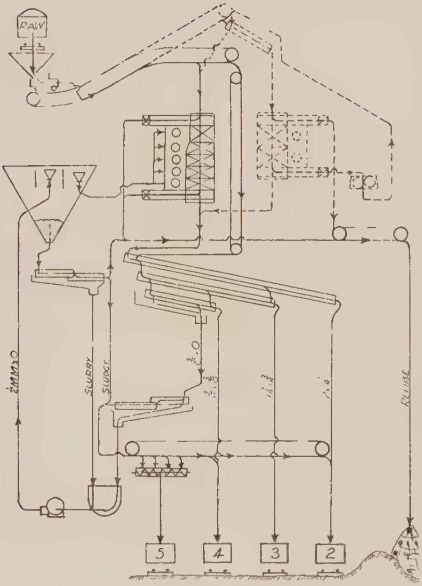
Bituminous Coal Industry
the last decade has made very
d advancement in the produc-
iethods and in the preparation
larger sizes of coal. During
ime period many types of ef-
mechanical coal burning equip-
have been installed in in-
al plants. Recently, this type
ipment has been introduced for
essure heating plants, and these
ations are increasing tremen-
each year. The increasing
r of installations of stokers for
ndustrial and domestic use in
iddle west has brought forth a
nt demand from the coal con-
s for a well-prepared, clean and
ly-sized stoker coal that will
he most efficiency in the indi-
types of equipment.

growing demand and the
ning of markets for properly-
ed stoker coal convinced us
ie smaller sizes of Illinois coal
od quality could be processed
positive low ash and uniformly
roduct, and a processing plant
omplish this would be a sound
nent even under conditions
ing in 1933.

investigation was then started
ermine, first, what in the judg-
of various mechanical and
plant engineers, constituted an
stoker coal, which would give
st efficiency in the mechanical
ient installed in the middle
econd, to locate a low-cost pro-
field of coal with inherent
s such that the raw coal could
chanically cleaned economi-
nd the clean product meet the specifications required; (this developed that a central processing plant to serve a group of mines in the same field would be more practical than if connected with only one operation); and third, after a thorough study of all types of mechanical cleaning equipment and plants then in operation, which one would give the most efficient and economical operation with the greatest amount of flexibility to produce a uniform low-ash, proper sizing and mixing.

The Universal Coal Washing Company has constructed near Pinckneyville, Illinois, in the heart of the great coal-stripping field of Southern Illinois, one of the most modern coal preparation plants in the United States. The contract was given to the McNally-Pittsburg Manufacturing Corporation, of Pittsburg, Kansas, for the designing and furnishing of equipment. In the judgment of leading engineers and others, the coal washing, preparing and sizing equipment in this plant is the most efficient obtainable. The plant is independent of any mining company but has established milling-in-transit rates with all the operations in the field and has made servicing contracts with some of the largest operators. An outline of the operation of this plant is as follows:

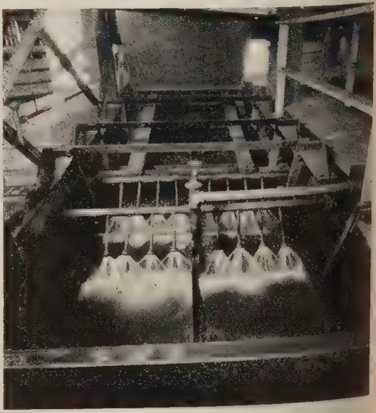
The incoming raw coal is discharged from the railroad cars into a receiving hopper at the bottom of which is located a reciprocating plate type feeder. This feeder is provided with an adjustable gate and is actuated by adjustable-throw cranks to provide for positive regulation of



Flow Diagram.

the rate of feed. A scraper conveyor transports the raw coal from this feeder to the Norton wash unit. Instead, however, of discharging directly into the wash unit, the coal is deposited by the conveyor into an open launder and flushed hydraulically to the washery compartment of the Norton wash box. This provides for better distribution across the width of the washing compartment and also insures adequate prewetting.

The wash unit is of the fully automatic type with two primary and three secondary washing stages. The depths of concentrate bed carried in the primary and secondary areas are separately adjustable at will and are automatically maintained at the desired depths by means of a patented mechanism operating through a counterbalance float which may be adjusted to float at any desired gravimetric level in the washing bed. The evacuating gates are controlled by these floats. Thus the setting of the float control valves determines the depth of concentrate bed, and the setting of the float counter-balances determines the consistency of the bed. The washing impulse as well as the control of the back section is effected through separate air and water valves for each washing stage. The entire washed product is sluiced hydraulically to a 3-deck flexibly mounted classifying screen which makes size separations at one and one-quarter, three quarters and three-eighths inches. The three largest ranges, corresponding to the No. 2, No. 3 and No. 4 standard Illinois sizing, deliver directly to cars on their respective tracks or optionally to a mixing conveyor which runs transversely across all four loading tracks. Gates in each of the screen decks provide for reassembly on the screen of any two adjacent size ranges, while, of course, the mixing conveyor provides for the reassembly of any two or more size ranges whether adjacent or not. Fresh water pressure sprays are provided on each deck of the classifying



View of Wedge Wire Dewatering Screens.

in order to remove any ad- fines or discolored wash water. ⅜-inch x 0 or No. 5 grade through the bottom deck of creen together with the wash and is laundered to the de- ing screens which are equipped ne-half mm. wedge wire. Each dewatering screens is approxi- y 20 feet long in two balanced ns. Fresh water sprays under re are applied to the coal near d of the first screening section the bulk of the wash water has removed. These sprays effec- remove any adhering fines as s rinsing off the fresh water might discolor the coal after . The remaining 10 feet of screen is utilized for the re- of the spray water. After ering, the coal discharges op- ly into the mixing conveyor or collecting spiral which loads ly into the cars on the No. 5 The gate, however, is in four s so that 25%, 50%, or 75% s product may be deposited in ixing conveyor for combination he larger size ranges while the e loads directly on the No. 5 This feature greatly increases tal flexibility of operation and it possible to load a wide y of combinations and mixtures et the most exacting market re- ents.

slurry passing through the lf mm. dewatering screens con- of course a considerable per- e of fine solids. This slurry is ed in the pump sump, and deliv- y a centrifugal pump to an ele- settling tank. This tank is coni- hape and the solid material set- the apex from which, by the head of water above it, it is through a pipe to the sludge which are mounted directly over the dewatering screens. These sludge screens are equipped with one-eighth mm. and one-quarter mm. wedge wire and the dewatered solids or sludge discharged from these screens may be optionally reassembled with the washed coal, discarded with the refuse or divided half and half between these two dispositions.

The water passing through the wedge wire of the sludge screens is returned to the circuit through the pump sump. This constitutes a closed circuit but it is a matter of record that there is no actual building of one-quarter mm. fines in the circuit. The explanation undoubtedly lies in the fact that the fines on the screen tend to constitute a filter, with the wedge wire serving merely as a supporting base and therefore very little solid material actually passes through the wedge wire. The clarified water from the top of the settling tank is returned by gravity to the wash unit for re-use and the only make-up water supplied to the circuit is the water which is applied in the form of the fresh water sprays.

A single drag type conveyor receives the rejects from both the primary and secondary elevators, as well as the dewatered sludge if it is to be discarded, and delivers the combination rejects to the refuse disposal site at some distance from the washer. At present a traveling scraper mounted on a high line and operated by an electric hoisting engine is being used to distribute the rejected material after it is discharged from the refuse conveyor.

The raw coal conveyor extends beyond the raw coal launder to discharge, when desired, upon a belt conveyor which will deliver directly to the classifying screens, thus bypassing the wash unit. This will make it possible to store unmarketable washed sizes during certain seasons of the year and then return them to the plant for resizing or mixing at seasons when they are salable.

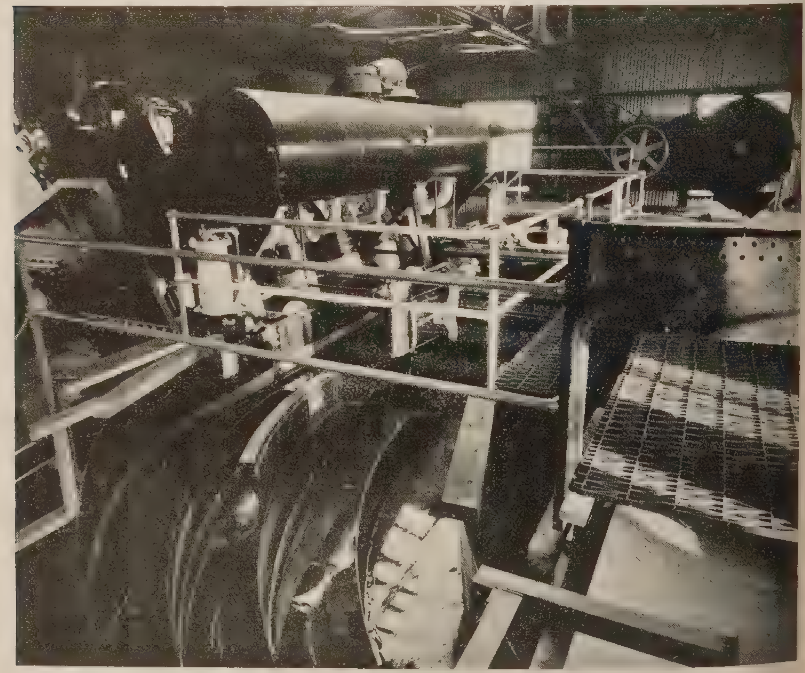
The plant has now an hourly capacity of 125 to 140 tons per hour feed, depending on the size of the raw coal, and on account of being independent of any mining operation is in a position to operate multiple shifts.

The design of this plant is for twice its present capacity, the raw coal feeder and conveyor as well as the classifying screens and mixing conveyor have sufficient capacity for the ultimate plant and the only equipment that will be necessary to double the capacity will be the addition of another washing box and battery of dewatering screens.

The entire flow as outlined above is shown on the flow sheet diagram, which also indicates the proposed extension to the plant.

A laboratory is maintained on the ground floor of the plant, where daily sink-and-float tests are made to determine the relationship of washer adjustment variables to specific gravity of separation, as well as the relationship of sink-and-float percentages to ash contents of coals treated. These data are the means of keeping an accurate check and control over the plant operation.

Where this plant is the only one of its kind now located in Southern Illinois, it is our firm belief that within a few years, the major portion of Southern Illinois coal from 2 to 0 inches will be similarly prepared.



Norton Automatic Washing Box Showing Launder.

DISCUSSION ON PROMOTING SAFETY

By DR. J. J. RUTLEDGE

Chief Mine Engineer, Maryland Bureau of Mines

. Bryson said in his paper that y is an investment. I would hat safety is an investment that re to yield a good profit. I e Mr. Forester of The Consoli- n Coal Company in the audience. could take from out of the files at company some figures regard- heir compensation costs, the dif- ce between that company's costs that of other companies' costs on for accident prevention, there l be a very handsome profit. I to take off my hat to the Safety rtment of The Consolidation Company. They have been re- g mine accidents. Recently two g men who had been working in son mine of The Consolidation Company, leased a small mine in yson seam and began to work it heir own account. Of course, carried accident compensation ance and they carried into their mine, where they were taking noney out of their own pockets y for timber and compensation, ame habits in which they had trained in the Consolidation . The Inspector reported that a person went into the mine ted by these two young men, were so well timbered that one think he was in a Consolidation Of course, these two young are making money in their coal ess.

cidents do not have to happen. ents **can** be prevented.

ferring to Mr. Bryson's charts, No. 1 is very interesting but I little from Missouri on this Some time I would like to a private discussion with Mr. Bryson and have him explain this data more fully. The same thing goes for his chart No. 2. Incidentally, this shows what a good, conscientious safety man can do when he is put in charge of accident prevention.

Referring to the cost of accidents —and I would say with considerable pride that Maryland was the first State to put accident compensation for mine employes on the statute— our cost for fatal accidents averages $5,000 if a man has a family, but it can be higher. It can go to considerably more than that. The average cost for burial is $125.00; medical and hospital costs can go up as high as $800 in each case. During the last few years that I have been studying mine accidents and comparing costs of compensation with my friends in other states, the records of two states have worried me considerably. One is Kentucky and the other is Alabama and I have come to the conclusion that they don't have any lawyers in either of those states; at least not in the coal fields, because I do not see any legal costs in their statements of accident costs. I know they could not keep the costs as low as they do if they have as many lawyers as we have in our compensation hearings in our State. Moreover, our Maryland law is so worded that the claimant need not be represented by counsel.

I was confronted the other day by the accident report made by a young man who had had three accidents in a comparatively short period of time. I went to the Accident Commission and said, "Here, something is wrong; this young man (I presume he is young, for he is a brakeman) has made three accident claims within a relatively short period of time. Investigation proved that in at least one of the instances not only the Mining Law had been violated but also the company's regulations. In common justice, in my opinion, when the Mining Law and company regulations are violated and an accident results, compensation ought to be denied the victim of the accident. Until the company gets behind accident prevention, it is useless to try to do anything in the way of preventing accidents. Moreover, unless you have good mine discipline, you might as well quit the fight against mine accidents.

Regarding the cost of mine accidents, our operators who are State-insured, report costs that run anywhere from 8c to 10c to 12c per net ton of coal production. Some of the figures that I have been privileged to see in the files of some of the self-insurers run anywhere from 1½c to 2c per net ton. So there is a very great saving to the self-insurer after all their expenses are paid.

There is no argument at all against safety. Mr. Bryson remarked to me just before I got to my feet that the rate in Kentucky was $9.50 per $100.00 of payroll just before some of the operators assumed their own insurance. I overheard the president of one of our largest companies talking with one of the members of the Accident Commission the other day and the president stated: "That his rate was $7.25," and he remarked, "that his present rate ought to be less as it is only seven-hour exposure now—one less than we had recently." This was a new thought to me but it is an argument to use on the compensation authorities.

The paper by Mr. Roy is very good. I have been following Mr. Roy's safety work in Ohio very carefully. Ohio has a higher rate than we have and if my memory serves me correctly—and I think it does—I think I have met Mr. Roy under other circumstances many years ago. It is a pleasure to see a man who fought so hard for the miners' interests fighting equally as hard for mine safety and it is an added pleasure to see the son of such a man up here reading a paper. It shows that he had better advantages than his father had at his age. I agree with Mr. Roy altogether in what he said that safety can only be promoted through a safety department. You will recall he said that a man in their mines is not merely a check number, that he is a man and so treated.

Incidentally, this man I referred to in our mines who had had three accidents, this is what we call an accident repeater and you will remember the trouble we used to have with the repeater in elections and polictical primaries. The accident repeater is the next thing that should be looked after. The employe or coal company that has too frequent accidents should be looked into very carefully. It took us three years to find out what was wrong with one of our largest mines where they had numerous accidents. Since a change in management this mine has had an excellent accident record.

If the rates for accident compensation continue increasing as they have, I predict that either the fund will fail and cannot be supported much longer or in some states the insurers will go back under the old common law, deplorable as that would be.

I would direct your attention to a paper read at the February meeting of the A. I. M. E. in New York by Mr. F. Robertson Jones entitled nen's Compensation—a Grow- urden on Industry." Anyone ias anything to do with mine accidents should read some of these papers prepared by Mr. Jones.

CONSTRUCTIVE SAFETY WORK

By E. L. BERGER

General Superintendent, Bell & Zoller Coal & Mining Co.

structive Safety Work as ap- o mines, means the prevention iuries to mine workers; the ation of removable hazards and velopment of right-thinking on in the minds of the manage- and in the minds of the men. ns work; both brain work and l work, but particularly brain

t of my experience in safety ias been at the two mines of ll and Zoller Coal and Mining ny, located at Zeigler, Illinois. iaking no claim that the safety of this operation is superior of any other operation. I do at it is far superior to many ons and that very substantial ss has been made there in work in the past five years.

ost-Time Frequency Rate has sed at No. 1 mine from 340 in o 74 in 1933, and at No. 2 from 201 to 80. The tons per me Accident have increased at mine from 3,300 in 1929 to in 1933, and at No. 2 mine ,800 to 9,200.

mines are thoroughly organiz- on mines which some people etards a safety program. The nnot be forced to wear pro- clothing, but every one of the 00 underground employes at No. 1 wear safety hats, and per cent of them wear safety toe shoes. At No. 2 mine, over 95 per cent of the 800 underground employes wear both safety hats and safety toe shoes. In 1929 hardly any protective clothing was worn.

Some months ago, a few employes with political aspirations, called a meeting for the purpose of eliminating safety clothing. However, men who had enjoyed the protection of safety clothing dominated the meeting, and the morning following the meeting, thirty-five men who had not previously worn protective clothing purchased safety hats and safety toe shoes.

The men are taking a real interest in accident prevention. Some have been active in developing new safety devices. I might add, that although the American born predominate, the list of employes is made up of almost all the nationalities usually found in coal mines, and that the operation may therefore be considered as fairly representative of the industry.

The records cited previously are not perfect records. There is plenty of constructive safety work yet to be done. The records, however, do show decided progress and I am convinced that the progress is due to the safety campaign initiated about the latter part of 1929 after a year of particularly distressing accidents.

This date did not mark the beginning of safety work. A safety engineer had been on our pay roll long before that time. We had safety devices and had our mines posted with safety signs. We kept accident records. We had much of the safety paraphernalia common to safe mines and also common to many of the unsafe variety. We have had occasion to make alterations and improvements in these branches of our safety work. We had not gone far enough, but we were not wrong in the type of our safety equipment.

We were wrong in our general attitude toward safety because we then believed many things which we now know are false. We did not change all of our ideas over-night. Perhaps we are still cherishing some false notions which are preventing a better record. We are trying to keep our minds open to new ideas on safety.

We did give up the idea that accidents just happen. and now know that they can be prevented. We started to prevent them and to sell this idea to our bosses through meetings, letters and full reports on every accident. We carried the report of every Lost-Time Accident in our monthly magazine with suggestions for avoiding a repetition of similar accidents. We established a few well defined, practical safety rules.

We knew that we needed the cooperation of the men, but were doubtful of our ability to obtain it because the mines were thoroughly unionized and there was plenty of labor agitation. We started a drive to have 100 per cent of our employes trained in first aid. Almost every employe took the training. We had less difficulty in inducing the men to attend the schools than we did some of the management. We then gave up the idea that the men, particularly union men, will not co-operate. We know that they will co-operate if the matter is properly presented.

While on the subject of first aid I wish to say in passing that the State Department of Mines and Minerals and the United States Bureau of Mines, were of wonderful help in furnishing instructors and speakers for the classes in first aid.

Some one may remark that first aid is not safety work. Technically that is true, but men in first aid classes are very receptive to safety suggestions, and I know of no better way to arouse the interest of a large group of men than in safety talks and discussions in first aid classes. At these meetings the men feel free to call attention to hazards and unsafe practices which the management may have overlooked.

As the safety work continued we gave up still another idea and that was that safety destroys efficiency and increases costs. We know now that the safe way of doing a job is the efficient way and that a safety campaign costs only a fraction of the saving that it effects. Compensation for accidents is not cheap. A man on a stretcher and the men carrying him are producing no profit. A haulage road tied up for the transportation of an injured man is non-productive. Every accident has a demoralizing influence on a working crew. Accidents are expensive—safety is not.

We not only gave up old ideas, but we acquired some new ones, new at least to us.

Safety work, in order to be effective, requires equipment such as safety devices, signs, illustrations, reports and accident records. Such equipment is an important part of the successful safety campaign, but the error should not be made of thinking that equipment is the main

Equipment bears about the relation to constructive safety that tools bear to the construc- of a building. Constructive whether applied to a building safety work, requires a clear g, authoritative, directing head ficient workers. Without these, tile to even hope for much suc-

structive safety work requires anship. A man new on a job ot automatically work safely. experienced men continue un- ractices until some one sells the safety idea. Our exper- ndicates that new employes are asily sold on safety than old. the past year we had occasion many new men and we took lar pains to see that they were of the hazards of their work safe practice. We did not the safety campaign as to old es, but up to the present the en have a better safety record hole than the older ones.

inuing on salesmanship. To nen, hard hats, safety toe shoes ggles appear as needless and fortable refinements. Unless ne shows the advantages of quipment and has the patience that only a proper fitting and table article is sold, the men t buy. The above statement vious that I hesitated to make made it only because I have f mine officials who have said hey thought that protective should sell itself. It may lf, but it will be a slow process ere accidents are likely in the ne.

ty work needs to be sincere. nagement cannot wink at un- actices and removable hazards ll secure strict compliances fety rules from the men. It must adopt practical safety suggestions if it expects the employes to have confidence in the sincerity of the campaign.

Safety work needs to be honest; honest in accepting blame when deserved. Most accidents can easily be explained as unavoidable when in fact it is questionable if there is such a thing as an unavoidable accident. An actual illustration: A main line locomotive is hauling a trip of coal cars. The motor runner is observing all safety rules. The track is in good condition, but on a curve one axle of the locomotive breaks letting the frame down onto the track. The runner is jolted off, run over and killed. That looks like an unavoidable accident. No one could be expected to know that the axle would break under ordinary working conditions.

However, special grades of steel for axles are available which are almost sure to eliminate accidents of this kind. If the accident is classed as unavoidable, nothing will be done to eliminate similar accidents. If an honest effort is made and the real cause of the accident is found, the proper grade of steel will be put in for other locomotive axles and there will be no recurrence of a similar accident, and another piece of constructive safety work will be performed.

Safety work needs to be continuous throughout the life of a mine. Special drives for no-accident months and competition for safety records in given periods are helpful in keeping the idea of safety to the front, but accident prevention should at all times be kept in mind and in order to do this, new signs, new devices and new schemes should constantly be developed. There can be no let-up in the propaganda for safety nor relaxation in the enforcement of safety rules.

Prevention of accidents is the very definite duty of every member of the supervisory force. In addition to being a duty, it is the greatest pleasure of any phase of mining work. What can bring more happiness to any man than the feeling that through his efforts he has kept death and injury away from his neighbors and friends?

THE COAL INDUSTRY AND THE GOVERNMENT'S HYDRO ELECTRIC PLANTS

By DR. E A. HOLBROOK
Dean, Schools of Engineering and Mines, University of Pittsburgh

(Reprinted by Courtesy of National Coal Association, Washington)

Foreword

At a meeting in Pittsburgh, Pa., on December 5-6, 1934, of the Coal Mining Institute of America, Dr. E. A. Holbrook, Dean of Schools of Engineering and Mines of the University of Pittsburgh, dealt with the subject of the coal industry and the government's hydro electric plants in an address which is herewith reprinted with his permission.

Dr. Holbrook is a graduate of the Massachusetts Institute of Technology and was for some years with the U. S. Bureau of Mines and Assistant Director 1920-22. He resigned from the government service to head the School of Mines of Pennsylvania State College 1922-27 and since 1927 has held his present post at the University of Pittsburgh.

The National Coal Association had no part in the recent Pittsburgh meeting of the Coal Mining Institute and no hand in Dr. Holbrook's appearance and address on that occasion. But his presentation of this subject is so timely, its concern to our industry so vital, and his factual argument so lucid and so authoritative that our association welcomes the opportunity to give it wide distribution.

Two Basic Discoveries

The greatest event of the 18th Century was the development of the steam engine by James Watt and others. He took the load of the world off the backs of men, where it had rested for untold centuries, and put in on machines. The greatest event of the 19th Century was the discovery of the principle of the electric dynamo by Faraday and its subsequent development by Edison and others to transmit power over great distances.

On these two basic discoveries has rested the material birth and the advance of the industrial civilization in which we live.

Stated in another way, we today must have power to do the work of the world. By the beginning of the 20th Century, coal had practically displaced all other fuels as a source of power. Indeed, it could be accurately stated that the amount of coal used in a country offered a good index of the relative material or comfort civilization of that nation. Mostly the coal was burned under boilers to generate steam which was used in turn to drive steam engines which gave us our power, but only at the place of generation. At about ime came the turning of the power into electricity by the no, transmitting this power miles by wire and again turn- into useful work by the electric . It is unnecessary to detail the el developments of electric ng and heating through the re- lecades.

ll water wheels, using the that is in falling water, had used in New England and else- before the birth of the Steam e. With the coming of the ads about 1830, it was soon that coal could be shipped Pennsylvania and used under s to make power for the England mills, far cheaper than ient water power could be de- d on the spot. In addition, the team power could be had 365 n the year, while with the older power many mills had to close gh the summer or dry season. in a few favored places did power hold its own with coal. practically all power was de- d by coal up to 1900 and city, where generated and nitted, depended on coal for its of power.

t before 1900 came the installa- f the great water power tur- at Niagara Falls, the direct rsion of this power into elec- and its transmission over con- ble distances. Here was an place for generating water , no expensive dam was re- and there was a year around stream of water stored in the Lakes. Thus, this electrical could be generated and sold cost far below the electrical generated by any steam plant time.

Race Between Coal and Water

From then on we have witnessed a race, as it were, between coal and water, as to which could furnish more cheaply the increasing demand for electric power. There is nothing about a steam coal power house to excite the imagination, but the thought of that great water power at Niagara being harnessed does grip the emotions of people. "White Coal Magic"—"A God-Given Source of Power"—"Mother Nature's Gift to the People"—it has been called.

Now the story would be simple if on the one hand we had a thousand Niagaras and on the other hand if inventors and engineers had been content to let coal-driven steam engines and boilers stay in the undeveloped state of that time. The coal business largely would have passed out of the picture and we could supply our power needs easily and cheaply by water. Following Niagara, other easily harnessed streams were used to develop electric power.

No White Coal Magic

Then we came to a period where more costly work was needed to harness the water power. Now, we have to build high dams to provide the water head needed. We must buy the land we flood. In most cases the dams themselves hold only a few days' supply and when drought comes we must either have an expensive auxiliary steam power plant or must build, at large expense, storage dams and reservoirs to furnish water during low stream periods. **Whether water in a stream is a boon or a useless flow, therefore, depends upon just one question: How much will it cost to harness it for what we can get out of it? There is no magic in it, only the figuring of interest, depreciation and sinking fund on the**

investment to see if it will pay.

Now as to coal. Thirty-five years ago we used what are now old fashioned boilers and old fashioned steam engines to gain our power. During the past thirty years the improvement in boilers has been remarkable and the perfection of the modern steam turbine has pushed the steam engine out of the picture. Then a 4000 H.P. engine was noteworthy. Today the Brooklyn Edison Company in New York operates a single 210,000 H.P. steam turbine.

Forty years ago it took 10-15 lbs. of coal to furnish a kwh. of electricity. In the most modern stations it takes about one pound of coal per kwh. **Thus, coal and the power engineers have brought about improvements that today makes it cheaper to develop electricity through coal than through water, at all points** excepting those where coal takes a long freight haul, or where extremely favorable conditions occur for cheap and continuous falling water.

Political Horse Power

Above all, the question of water vs. coal is an economic and engineering question. It is not a political question and can only remain one by using public money to disadvantage. The people just have the notion that every stream represents golden dollars running away to the sea, and that a few millions of public money spent on a dam would bring them eternal peace, plenty and happiness.

I quote now from the speech of a Congressman, made some years ago, with reference to the Muscle Shoals power project:

> "The mighty and God-given waters of the Tennessee River, which, having been harnessed at Muscle Shoals by the power of man, shall subject to his mighty Will turn Sun Kissed Dixie into a land of peace and plenty, and forever free the southern farmer from the thraldom of the fertilizer trust."

I call this political horse power.

Now the facts are that the Tennessee River is a flash stream, wide and deep in spring and low in the fall. From the stream records you can find out for yourself that for several months in the year, the continuous water horsepower available at Muscle Shoals is less than 100,000. This is about one-half of that produced by a single electric turbine generator at the Brooklyn Station, previously referred to, and about one-third of that available every day at the Colfax station on the Allegheny River.

Muscle Shoals Costs

Government figures show that 47,000,000 dollars has been spent in building the dam and electric equipment at Muscle Shoals. With interest and depreciation at 6 percent, you and I are paying an annual interest charge on Muscle Shoals of $2,820,000. Now a steam plant to make the same power would cost about $8,000,000, which, with interest and depreciation at 8 percent makes the yearly carrying charge $640,000. The coal required would be about 375,000 tons at $4.00 per ton—$1,500,000. Total yearly cost of the steam plant, $2,140,000, or nearly seven hundred thousand dollars a year less than the government water power plant. You will see from this that the savings over the hydro-electric plant would pay for the steam plant in ten years, while the government plant will be paid for by our great grandchildren. I have put the coal cost at $4.00 per ton because the Muscle Shoals is within a stone's throw of the Alabama and Tennessee coal fields.

st you feel that this is a partisan
nent, I quote from an official
t of M. C. Tyler, Lieutenant
el, Corps of Engineers, U. S.
, dated October 29, 1931:

> 1. The Government's power
> ts at Muscle Shoals and the
> osed Cove Creek development
> not suitably located to serve as
> main generating system of an
> nsive indepedent power system.
>
> 2. The construction of an inde-
> lent system would involve ex-
> litures of public funds.
>
> 3. The cost of transmitting
> er in such a system would be
> and the reliability of service
> ng distances from the generat-
> system would be poor.
>
> 4. The construction of such an
> pendent system would be an
> omic waste, in that it would
> icate transmission facilities
> ample to serve the region.
>
> 5. It may be expected that the
> cit from the construction and
> ation of such a system which
> have to be met by the Federal
> sury and by the general tax-
> rs, will largely exceed any sav-
> from lower rates which may
> ue to the limited local public
> ed."

e report has been lost in the
erland at Washington.

takes about two men working
mining company to produce
tons of coal per year. Thus
ne hydro plant puts out of work
nine employees and destroys a
unity dependent upon them. It
off the railroads 150 train-
of coal and the train crews and
es the railroads of perhaps
000 in yearly revenue. Is this
reatest good for the greatest
er? I submit that it is not.

this is not the whole story.
otal cost at Muscle Shoals for
xiliary steam station, obsolete
e and fertilizer plants, etc., has
ne cost up to $127,000,000.

TVA's 149 Dams

Now comes the Tennessee Valley Authority (TVA). They must first furnish more water for Muscle Shoals, so they are building upstream at Cove Creek, Clinch River in Happy Valley, the Norris Dam, of which the primary purpose is to furnish storage water to increase the low water flow at Muscle Shoals. A laudable effort, but adding some 38 millions of capital expenditure on which interest and depreciation and sinking fund must be paid.

The full plan of the TVA contemplates something like 149 storage and power dams in the Tennessee basin, involving a hydro-electric system whose total cost will exceed one billion dollars of taxpayers' money. Within the radius of, say 250 miles of these developments, are already private steam and water power plants with 40 percent excess capacity over requirements. At a generous rate of expansion it would take over fifty years for this section to absorb the government-generated power, even if no additional private plants were built. If the government is to give away power, mills and industries will move there, leaving us what here?

You will note that I have not discussed the cost of transporting and distributing electricity, because it will cost about the same to distribute and sell elecricity, no matter if it is generated from water or from coal. If there is a difference it is in favor of coal, because coal plants usually are erected near centers of consumption, while water power plants are where the water power is, often remote from centers of population. Actually the cost of the coal represents only from 18 to 28 percent of the cost of electricity ready to light our houses. Likewise the water-generated electricity represents not more than the same percentage of the cost of that electricity ready to use.

Recently the TVA bought out the Tennessee Public Service Company franchise and plant at Knoxville, under conditions that some lawyers have described as under duress. The citizens eagerly voted for the cheaper government power. I note, however, that the PWA had previously approved a grant and a loan to Knoxville of $2,600,000 to build a new municipal electrical distributing system. Is it right to destroy a public utility that pays taxes to give away cheaper electricity on which the taxes and interest to support the high investment are paid for by us all? In other words, **the people of the whole country will pay for the Tennessee Valley cheap electricity and with a total cost greater than coal-generated power there.**

To sum up, the proposal in the Tennessee Valley, is

Muscle Shoals cost	127 million
First TVA appropriation	50 million
To TVA by President's direction	25 million
To TVA from other government depts.	11 million
TVA estimates for five-year program	205 million
Committed for use by other government depts. in the Tennessee River basin	56 million
Total	474 million

Projected future dams and power facilities (149 in all) will add another 500 million dollars to the foregoing total.

Years ago the government properly constructed irrigation dams in the West. Then came the idea of generating electric power at these dams. If irrigation was desirable, then no one objected to the generation and sale of electric power there, especially in regions in the far West, remote from coal. But these new schemes of the government go far beyond the boundary line of good economics.

I have here a map showing the division of nearly the whole country into new authorities, among which are the St. Lawrence, the Loup River in Nebraska, the proposed Arkansas River Watershed Authority, the Wabash Valley Authority. The primary purpose of all of them is to furnish electric power at a capital and operating cost far beyond that if coal were used.

St. Lawrence Power Project

As an illustration, take the St. Lawrence Power project. If carried out, it would produce 6½ million horsepower, to be distributed largely in New York and New England at an estimated total capital cost of $350,000,000. Now, Pennsylvania coal furnishes most of the electric power in those states. This water power would destroy the market for and replace annually 58 million tons of bituminous coal, or more than two-thirds of Pennsylvania's present production. It would do away with 19,000 freight trains per year on our railroads, each train hauling 3,000 tons of coal. One hundred thousand coal mine employees and their families would have to find new homes. Actually whole counties in Pennsylvania would be left nearly without population or taxable property.

PWA'S Loup River

Early this year, when the Secretary of the Interior announced the project out in Senator Norris' territory for the development of the Loup River, the National Coal Association wrote him that the project would displace 200,000 tons of coal annually and throw out of employment a large

er of coal miners and railroad
yees. The Secretary made this
:

> The statements you make in
> letter to the effect that cur-
> can be generated more cheaply
> he vicinity of the Loup River
> ect by steam-generating plants;
> the territory will not furnish
> arket for its output, and that
> plant would operate at much
> than its rated capacity, are all
> ments that have been made
> re. The fact that the project
> approved, notwithstanding, in-
> es that they were found to be
> out merit."

Conclusion

ntlemen, the coal industry of
country gives employment di-
to more than half a million
nd furnishes 30 percent of the
t for our railroads. In western
ylvania, were it not for our
we probably would be a small
unity surrounded by a not very
rous agricultural district. At
six counties surrounding Pitts-
prosper only when coal can
duced there.

our contention without merit
a piece of paper and a pencil
y show in most of the projects
nder way, or under considera-
y the government, that elec-
can be produced more cheaply
by coal; that the bulk of taxes
ne of our counties comes from
ands; that our mining popula-
ill have no other prospect of
yment; that our railroads can-
ist without the freight revenue
coal; that government revenue
d from Western Pennsylvania
g used in part for grandiose
ts in other parts of the country
ill impoverish us?

ink the coal industry is willing
xpects to meet fair competition
the government. If a great
plant can be erected and operated somewhere more cheaply by water than by coal, we acknowledge defeat. We ask, however, that the competition be put on an economic basis with all factors included. If this is done, we have no fear of the proper economic decision.

Thomas Edison, in 1929, said:

> "We shall steadily require more power, but a great deal more fuss is being made over hydro-electric power than its intrinsic value warrants. The first and best source of power is coal. Water power is a political issue, not a business one. The government never really goes into business, for it never makes ends meet. And that is the first requisite of business. It just mixes a little business with a lot of politics and no one ever gets a chance to find out what is actually going on."

Last year, while in Washington, I talked with an enthusiastic government "White Water Magic" booster. "Well," said he, "you do not understand. You approach this question from your head and not from your heart. You do not appreciate its social value."

To those of you who place high stress on the social value of great quantities of electrical power from water, my answer is that it is the same kind of electricity that you get from using coal, and that we, in the coal industry, can show a population numbering millions now happily engaged in mining, transporting and utilizing what is also a "God-given source of power"—**COAL.**

Resolution adopted by the National Coal Association at its 15th annual meeting at Washington, October 27, 1934.

> Resolved, That the hydro-electric power development now being initiated by the TVA and by other government agencies, and the St. Lawrence project, which is to be revived for action by the next Congress, is without economic or social justification and on the contrary is both

wasteful, extravagant and destructive and ought to be speedily halted. The consummation of this program will increase unemployment instead of relieving it; will dislocate and destroy private industry instead of stimulating it; will effect direct losses of incalculable amount upon the coal industry and related business, upon the railroads, and upon the privately owned public utilities; will impose new large and unnecessary burdens upon the American taxpayers, and, taken in its entirety, this stupendous water power development is calculated to retard rather than promote recovery.

PROCEEDINGS OF ILLINOIS MINING INSTITUTE FORTY-FIRST ANNUAL MEETING

Friday, November 2, 1934

Held at Hotel Abraham Lincoln, Springfield, Illinois

MORNING SESSION

10:00 O'clock A. M.

President Treadwell: Members of the Illinois Mining Institute, it gives me a great deal of pleasure to open the Forty-second Annual Meeting of the Illinois Mining Institute and to see such a good attendance and so many present. We have been a little late getting started this morning. I think we have a very interesting program. I believe we had better get right along with it.

Is the Mayor here this morning? He has been out of the City, and we did not know whether he would get back. If not, we will go right ahead.

The first order of business is the reading of the minutes, but as the minutes are all printed in the Year Book I believe we will dispense with that.

The next order of business will be the report of the Secretary, Mr. Schonthal.

REPORT OF SECRETARY

November 2, 1934

To the Officers and Members of the Illinois Mining Institute:

The year just brought to a close has been a very busy and highly satisfactory one, as will be noted by the reports showing the cash position of the Institute as well as its position from the standpoint of membership.

There has been quite a bit of activity on the part of the major committees, whose reports you will hear later.

The boat trip was a very successful one from the standpoint of members on board, and it showed a profit. There were 113 members on board, which is probably the largest attendance in many years.

The yearbook, through the efforts of the very active committee on advertising, turned out to be very satisfactory and quite profitable.

During the year just ended, the Secretary's office sent out upwards of 10,000 pieces of mail. This, combined with the regular work of taking care of handling dues, paying bills, and other details, entailed quite a bit of work on the office of the Secretary, but the results are very gratifying and make the work very well worthwhile.

The hope expressed in my report last year, that our membership would reach at least five hundred, has been fulfilled, due to the very good work e membership committee headed H. Taylor, Jr. We are hoping the coming year will enable us ld all our present members and many more.

e Institute is just now beginning lize some of the hopes that have held for it in the past few years, t constructive work that will be ıl to the Coal Mining Industry of tate can be accomplished. The am laid out for the coming year st constructive, and you will be ned from time to time of these ties.

ring the year we have lost two of our members: W. G. Hutton and Fred K. Clark, who was one of our first life members. Letters of condolence were dispatched to the bereaved families.

I wish to express my appreciation to all the members, the Executive Board, the Officers, and the Committees for their ever ready willingness to co-operate to lighten the burdens of the office of the Secretary.

Respectfully submitted,
B. E. SCHONTHAL,
Secretary-Treasurer.

Next in order of business is the report of the Auditing Committee:

REPORT OF AUDITING COMMITTEE ILLINOIS MINING INSTITUTE CASH STATEMENT NOVEMBER 1, 1934

Report of Auditing Committee

ce in Bank, November 1, 1933	$1,416.34
paid in 1934	1,452.00
est on bonds, profit on yearbook and boat trip	1,063.75
	$3,932.09
general disbursements: printing, postage, telephone, telegraph, c.	1,303.10
ce in bank, November 1, 1934	$2,628.99
on hand 10-31-34, not deposited	6.00
cash, November 1, 1934	$2,634.99
ce in bank, November 1, 1933, per above	1,416.34
for year 1934	$1,218.65

Life Membership Account

ce October 30, 1934	$201.97

ıe foregoing is found to be correct:

D. H. DEVONALD,
W. J. AUSTIN,
JOHN A. GARCIA,
Auditing Committee.

Bonds Owned by Illinois Mining Institute

-Chicago, Burlington & Quincy Railroad Co.	$1,000.00
-Missouri Pacific Railroad Co.	1,000.00
-Western Union Telegraph Co.	1,000.00
-U. S. Treasury Certificates, $1,000.00 each	2,000.0

er Joyce: I move the accep- of the Secretary's report.

sident Treadwell: You have heard the report. I believe it is in order for a motion to accept it and place it on file.

(Which said motion was duly seconded.)

President Treadwell: It is moved and seconded that the report be accepted. What is your pleasure?

(Whereupon the said motion was unanimously adopted.)

President Treadwell: We will now have the reports of the Committees. We will hear first from Mr. Taylor, of the Membership Committee.

Chairman H. H. Taylor, Jr. (Membership Committee): Mr. President, just a year ago we had 319 members, and the President expressed a desire to bring this up over 500. Thirty-nine different members of the Institute contributed during the year and co-operated with the Committee to turn in 189 new names, so that at the present time our total membership is 508. We have 479 regular dues-paying members, three honorary members, and twenty-six life members.

During the year we added the 189 regular members as mentioned, and added four life members, making a total of 508 members in good standing.

It is interesting to know that the out-of-the-State membership is approximately thirty. We have the States of California, New York, West Virginia, Pennsylvania, Kentucky, Indiana, Wyoming, Ohio and Nebraska represented, among others. An organiaztion gaining interest like this certainly ought to be worthy of support by everybody, and I would like to suggest, Mr. President, that all those attending the meeting who have not registered should do so at the noon recess. There is a desk outside, and we wuold like to have the name of every man here who has not registered.

President Treadwell: You have heard the report of the Membership Committee. Personally, I think it is a very fine report. I think it is wonderful. I think the members have taken an active interest in bringing up this membership, and have shown the true spirit of the Illinois Mining Institute. I think the suggestion of the Chairman that all those who have not registered should do so at noon is a fine idea. We owe that to Mr. Taylor.

The next Committee to report will be the Committee on Appropriation for Mineral Industry Research, Mr. T. J. Thomas, Chairman.

Chairman T. J. Thomas (Committee on Appropriation for Mineral Industry Research): Mr. Chairman and gentlemen of the Institute, at the fall meeting last year of the Illinois Mining Institute a special Committee was appointed to deal with matters affecting the Geological Survey and the Engineering Department of the University of Illinois. On that Committee, besides myself, is Mr. George B. Harrington, President of the Chicago, Bloomington & Franklin Coal Company, and Mr. George N. Reed, of the Peabody Coal Company.

The Committee held a number of meetings. On behalf of the Committee, I appeared before the Public Works Administration Committee for the State of Illinois to develop their reaction with reference to making an appropriation to properly house the Geological Survey. After much discussion, that Committee agreed to recommend to the Public Works Administration at Washington an outright cash appropriation of thirty percent of the cost of providing a building, with the understanding that the State of Illinois would provide the other seventy percent, and reach down into its portfolio and lodge with the Public Works Administration

s or securities of the State of
ois which would be pledged with
'ederal Government in carrying
his project. We discovered after
: into the matter that the State
linois was not prepared to lodge
ity percent of the cost.

en after that meeting we had
al conferences with Dr. Daniels,
g President of the University of
is, with Dean Willard of the
neering School of the University
d Dean Willard has since been
ted to the Presidency of the
ersity of Illinois—with the Presi-
of the Board of Trustees, and
several members of the Board
rustees, and with Dr. Leighton,
of the Geological Survey.

came to an understanding that
ar as the University was con-
d they would work in co-opera-
with the Geological Survey so
there will be no duplication of
or effort in carrying on the
of the mineral industries of the
, and dealing particularly with
natter of coal.

say to you that this Committee
had something like six or seven
ings all told, maybe a few more.
glad to say to this Institute
morning, to you, Mr. Chairman,
Mr. Schonthal, that I hold in my
ssion a letter written by Dean
rd, or President Willard, of the
ersity of Illinois, to John J.
nan, Director of the Department
Registration and Education in
gfield, in which he calls atten-
to the fact that in the requests
ppropriations to carry on the af-
of the University of Illinois
has been included in that re-
an item calling for an appro-
on sufficiently large to properly
the State Geological Survey,
o pay the operating expenses
from year to year in connection with that building.

If I may take just a little of your time, I would like to read a paragraph of that letter—this particular one: "In addition to the request for capital additions for strictly University purposes, there is included by request of the Board of Natural Resources and Conservation an item estimated at $82,500.00 for a new building for the State Surveys which are a part of the new Department of Registration and Education, but by direction of the General Assembly are housed at the University of Illinois. This figure covers the actual cost of the buildings, including plumbing and heating and lighting, and the cost of connecting it to the University power plant. Purchase of the site is requested in the special appropriation for land already mentioned. If the appropriation for the building is made, further additions must be made to the University Budget to provide for the expense of operation and maintenance of the building, estimated at $4,300.00."

I might say to you gentlemen one of the difficulties we ran into in the matter of getting the Public Works Administration to make the appropriation to take care of this housing facility is the fact that the State Geological Survey and University of Illinois function under separate awards of the legislature.

I might say I would like to move the adoption of the following resolution:

BE IT RESOLVED, That the Illinois Mining Institute endorses the proposal of the Board of Natural Resources and Conservation that the State of Illinois provide a suitable and adequate State Natural Resource Building at the University of Illinois to house the researches of the State Geological Survey Division;

Be it further resolved, That the Illinois Mining Institute use all of its good offices in properly achieving this objective and in securing the cooperation of all of the mineral industries, engineering organizations, and other related interests in the State, whose support will be helpful toward this end; and

Be it further resolved, That a copy of this resolution be spread upon the minutes of the Institute and a copy be sent to His Excellency, the Governor of the State of Illinois, to the Chairman of the Appropriations Committees of the House of Representatives and Senate of the General Assembly, to the Director of the Department of Registration and Education, to the Director of the Department of Finance, to the members of the State Board of Natural Resources and Conservation, to the President of the University of Illinois, to the President of the University Board of Trustees, and to other interested parties.

Mr. Chairman, I move the adoption of this resolution endorsing this action on the part of the President of the University of Illinois.

President Treadwell: Gentlemen, you have heard the motion.

C. F. Hamilton: I second the motion.

President Treadwell: You have heard the motion, which has been seconded.

(Whereupon said motion was unanimously adopted.)

President Treadwell: Gentlemen, you have heard a very comprehensive report from this very important Committee. I think this Committee has had the hardest task of the year. I imagine every man in here knows how hard it is this year to go out and talk somebody out of money. I think Mr. Thomas and his associates have done a very, very fine job, and I think the Institute is showing progress. A few years ago this Institute was instrumental in the starting of this research work. And now to come along and follow it up by advocating the purchase of bulidings and carrying it on shows we are living up to prospects. It shows the men doing this work have a very great deal of interest in it. I think it is very fine, and I thank you very much.

The next Committee will be the report of the Essay Committee, by Paul Weir. Is Mr. Weir present? We will postpone that.

The next report will be the report of the Nominating Committee.

Secretary Schonthal: I have the report of the Nominating Committee. I do not think any of them are here today.

President Treadwell: Will you read the report, Mr. Schonthal?

REPORT OF NOMINATING COMMITTEE

Read by Mr. Schonthal.

November 2, 1934

To the Officers and Members of the Illinois Mining Institute:

We, the undersigned members of your nominating committee, in accordance with the duty of nomination given to us hereby nominate the following officials and executive board for the coming fiscal year of our Institute:

OFFICERS

President—C. J. Sandoe, St. Louis.

Vice President—T. J. Thomas, Chicago.

Secretary-Treasurer—B. E. Schonthal, Chicago.

EXECUTIVE BOARD
C. Argust, Taylorville.
J. Austin, Chicago.
ul W. Beda, Chicago.
as. F. Hamilton, Chicago.
F. Dodd, Danville.
n. J. Jenkins, St. Louis.
M. M. Leighton, Urbana.
nes McSherry, Springfield.
ed S. Pfahler, Chicago.
H. Taylor, Jr., Chicago.
rry A. Treadwell, Benton.
ul Weir, Chicago.

Very truly yours,
JOHN E. JONES,
Chairman.
J. W. STARKS,
JAS. S. ANDERSON.

esident Treadwell: Are there uggestions or changes any of the ers desire to make in the re-

H. Johnson: I move the accep- of the report of the Nominat- ommittee. I further move that ecretary be authorized to cast nanimous ballot of the Institute ose nominated.

hich said motion was duly ded.)

sident Treadwell: You have the motion.

hereupon the said motion was mously adopted.)

retary Schonthal: The Secre- by the authority given, casts te of the Institute, and the Of- and Members of the Executive are duly elected.

sident Treadwell: The next in order is any unfinished ess. If there is none, the meet- s now ready to take up new ess. If there is no new busi- is there any communication to bmitted?

retary Schonthal: Mr. Presi- I have just one or two com- ations which I will not read. We extended an invitation to Mr. Finch, Director of the Bureau of Mines at Washington, to come out as our guest. Mr. Thomas was in Washington last week and was good enough to see him personally, but he advised it would be impossible for him to be here, since he was very busy in Washington and could not come. I have a letter of regret for his inability to be on hand.

I have a letter from Mrs. Fred Clark which we just received yesterday, acknowledging the communication sent her on the passing of her husband.

I just received a telegram from Mr. G. W. Wilson from Marshall, who states he was delayed on account of motor trouble and probably will not be able to attend. He regrets this and wishes us success in the meeting.

Those are all the communications we have to offer.

President Treadwell: This brings the business meeting for this session to a close. We will now go to the morning program.

It gives me a good deal of pleasure this morning to ask one of our Past Presidents, a man you gentlemen all know, to act as Chairman of the meeting. Mr. Charles Hamilton.

Chairman Hamilton: Mr. President and members of the Institute, I feel a good deal like a rookie trying to pinch hit for Babe Ruth this morning. Mr. Argust was to be Chairman of this morning's meeting. But having been forced into service by President Treadwell, I could not help but inflict myself on you and endeavor to handle the program to the best of my ability.

Our first paper is "Use of Airdox at Herrin No. 7 Mine," by Mr. G. S. Jenkins, Mine Engineer, Consolidated Coal Company of St. Louis, St. Louis, Mo. Mr. Jenkins.

Mr. G. S. Jenkins: Mr. Chairman and Gentlemen, we have experimented with the use of Airdox for several months, and possibly know less about it than when we started. Nevertheless, we will give you a little of our experience.

USE OF AIRDOX AT HERRIN NO. 7 MINE

By G. S. JENKINS
Mine Engineer, Consolidated Coal Co. of St. Louis, St. Louis, Mo.

At this mine we are working No. 6 seam, but the coal at this location seems to be of a friable nature, and tends to "chill" very easily when powder shot, which results in an excess of screenings as compared to most other mines in the vicinity. The seam itself has streaks of mother coal throughout and slips are prevalent in practically every room. A face may appear perfectly solid but upon shooting a slip will show up which will spoil the calculations upon which the shots were prepared. Often a shot will pull over cutting through an adjacent powdered hole, or on the other hand a slip may be within a few inches of the shot, thus cutting off the effectiveness of the shot and leaving an excess burden for the adjacent shot. In addition to this, the top and bottom are rolling and at times the coal pinches down to about 3 feet for a few cuts and then goes back to the normal height about 7 feet.

About 18 inches of top coal are left in most places. This is not a natural parting, but the six inch as it is called must be left to provide adequate strength. When the coal is shot to pull to the natural parting, 12 inches of top coal is left, which will come in, some week or two later, exposing a roof of shale which when exposed to the air, soon rashes and falls in pieces which vary in size from practically nothing to pieces weighing 5 or 10 tons.

This above condition makes it necessary to leave the 6 inch and to shoot an unnatural parting, which further tends to make the proper shooting of the coal a difficult problem.

Could the holes be loaded and shot single and the proper charge placed in a hole after the adjacent one was shot, this difficulty could be well overcome, but with the necessity of shooting on the off shift, and the limited amount of time due to the necessity of allowing sufficient time for the night shift, and examination of the mine,—this is not possible. The result of which being a tendency to "overshoot" the face to avoid stuck places and improper preparations for mechanical loading.

While this condition offers no problem during the summer months, it presents quite a different condition during the winter months when the market swings to larger sizes.

For the above reason we viewed with much interest the experiments of the Franklin County Coal Company at their Royalton Mine, with the use of compressed air as a means of shooting the coal. They were shooting the holes "on shift," single hole at a time, and getting a grade of coal which was low in screenings yet well shot, and suitable for mechanical loading.

out the time we began to get
siastic about the idea, Airdox
on the market, and we installed
f the compressor units, installed
a territory for two Joys and re-
l all permissible from the sec-

e fact that the strength of the
e could be varied at the will of
erator was of great importance,
enabled us to increase or de-
e the charge as was deemed
sary when a shot pulled to a slip.
eaking of the application of
ox," the word "shell" will be
to designate the container for
r and the word "shot" to desig-
the release of the air—as this
be analogous to powder dis-
e.

e first shell we used contained
180 cubic inches and could be
l in a hole drilled by the No.
Little Giant Drill. This shell,
er, was discarded some months
as it was too small to properly
the places unless an excessive
er of holes were drilled in a

t a shell with some 300 cubic
capacity was tried—the results
better but a large number of
showing tight corners, so a
of some 400 cubic inches capa-
as substituted. This shell being
ches long, 4" in diameter and
s about 70 lbs. This shell
did the work, but necessitated
sing of a 474 drill, which is a
an drill.

ut 6 to 7 holes are necessary
24 ft. place and the two men
le to keep up the drilling for
oy loading unit. The coal on
n is about 7½ to 8 ft. high and
ercut 8½ ft. The drillers drill
ecessary holes and throw back
ttings. The same two men are
d on this work as were formerly on the run as drillers and shooters. The territory being shot with airdox having two Joy crews, of course requires 2 drilling crews. The two Joys are under one face boss and work both sides of a panel making their own entry development as they go along. When practical, a modified checkerboard system is utilized and an effort is made to provide the room face and a crosscut for the loading unit after each move. Room being driven at 60° with the entry and several rooms picked up off of one to provide car change and more suitable transportation conditions, also incidently decreasing the amount of track and maintenance of rooms.

In shooting the territory, our present set up, which necessitates purchased power, makes it advisable to do the Airdox shooting on the second shift, altho occasionally we shoot a few places on the day shift when additional falls are required for the day's loading. We are further handicapped in shooting on the day shift due to traffic problems. We are keeping a minimum of working rooms (about 6 to 10) for each loading machine.

So with 2 Joy loaders, 2 cutting machines, 2 drill trucks and three locomotives operating in a maximum of 20 rooms off of 1 pair of entries, the air compressor doesn't have much chance to get around and shoot for the whole territory during the working shift. Hence it is used on second shift altho when we complete our power plant and have an unlimited power supply we intend to provide adequate transportation facilities to shoot on the day shift, as well as on the second shift. The thought being to make a compressor unit do the shooting for 4 Joys.

The operating crew for the compressor unit comprises 2 men at shooters wages, one man operating the compressor and the other placing the shells and making the necessary calculations as to the charge required, which is from 5000 lb./sq. in. to 12,000 lb./sq. in.

After placing the shell in the hole he indicates to the operator the desired pressure and the compressor is started. The air is supplied to the shell through about 50 or 60 ft. of ⅜" copper tubing. When the desired pressure has been obtained the compressor is shut off and the line bled by means of a quick acting valve and the drop in pressure at the supply end of the shell, causes the valve in the shell to fly open so violently that the air is released with explosive force and breaks down the coal.

The face man or shell man then places the shell in next hole after observing that all tube connections are still intact, makes his calculations as to charge required for next hole, and the process is repeated.

The skill of the operator of course is limited to the gauging of the pressure, but even with the holes already located; by the use of correct pressure he can do some exceptional estimating.

This brings up the question of drilling. The proper drilling is just as responsible for a satisfactory preparation of the coal as the proper charge—perhaps just a little more so. We are convinced that the proper method is a hole straight in and within about 6" of the undercut. Gripping holes appear not to pull properly and to throw out the shell, with insufficient action on the coal. The tendency of airdox on account of its slowness is to not pull much above the hole itself, hence the top holes have to be practically to the desired height of roof. An Airdox hole on the solid tends to transform the hole into a cannon barrel and project the shell rather than break down the coal.

Standard practice is to pull the shell back some six inches from the back of the hole. This tends to produce a better coal with less chance of shell projection. As for tamping up the holes—this is impractical account of a portion of the first shot of air which seats the valve, is discharged through the valve just prior to its seating and cracks the tamping rendering it useless. As to the effectiveness of re-tamping of the holes after seating of the valve, we are not in a position to know, as the results do not indicate that the investment of another man shift on this operation is practical.

As to the mobility of the compressor; I might state that it is self-propelled by a tramming motor and is equipped with suitable brake to keep it at all times under perfect control. Further, we have equipped the machine with a trolley pole, which makes long moves of no consequence as the unit travels at a speed of some 6 or 8 m.p.h. when trolley wire is available.

The compressor motor which is 50 H. P. is started through a push button operated contactor controller, which insures quick convenient operation, with adequate overload protection. The compressor cylinders of which there are four, operating in series, are water-cooled, altho the last two are going to be replaced by an air-cooled type. The piston seals on all stages are of piston ring type and inter-coolers are provided between stages with a water cooling system consisting of an adequate automobile type radiator and belt driven fan. Maximum cycle of operation indicates ½ time for pumping cycle while in one place, i.e. approximately 2

es are required to pump a shell
after so doing another two
es are consumed inspecting and
ing shell and line and in calcu-
desired charge for next hole.
ile our experiments convince us
additional labor, expense and
enance, offset the costs of
er shooting, and then charging
hat we consider an adequate
e per ton to pay for the
ne, we can still net a few cents
creased realization at the pre-
market, which after all is the
of first importance.

irman Hamilton: Mr. Jenkins,
half of the Institute I want to
you for that very interesting
I am sure it must bring up
minds of the men present some
ons, and the matter will be open
discussion of the paper.

sident Treadwell: There is one
ent in that paper that I would
o get a little more fully. I
noticed in various mines where
se Airdox, or air shooting, that
umber of instances they do not
their holes. In Mr. Jenkins'
he said it was useless. I would
know why. I would like to
whether they get better results
he hole tamped or if they do
From the paper I would judge
lo not. If we can eliminate
g in the shooting, we have
ated one operation which is
ice.

rman Hamilton: Mr. Jenkins,
ou add something to that
n?

Jenkins: When we first be-
r experience, we tamped the
But with this Airdox shell,
you first start to pump the
e first shot seats the valves
it seats a small quantity of
s out of the valves into the
f you have the hole tamped
up, it cracks the tamping before the discharge. So we decided not to tamp it. We tamped some and not others, and could not tell any difference between them, so just discontinued tamping them. Does that answer your question?

President Treadwell : It does, yes, sir.

Mr. T. J. Thomas: Mr. Jenkins, did you shoot with Cardox, where the shell was charged by the mine safety company, or where you charged it yourself and transported to the face, and now are using the compression? If you had both systems at your mine, which do you think the most efficient and effective and least expensive?

Mr. Jenkins: We never used Cardox on a production basis. We had some test runs made with it, and the indication we got from the experiment with the Cardox, it is considerably more expensive than the Airdox. As for the use itself, our experiments indicate that the result is just about the same with the Airdox as with the Cardox. As I mentioned before, this comparison is just a rough observation, as we have no data of consequence regarding the application of Cardox.

Does that answer the question?

Mr. Thomas: Yes, sir.

Mr. John G. Millhouse: I would like to ask if you have any difficulty with the different shells?

Mr. Jenkins: We have had some. Occasionally there is a shell that will fly. I cannot say it is a rule. Rather it is the exception. When the shell is projected from the hole, it usually is projected six or eight feet, or falls out at the face itself. Ordinarily the shell will stay in the hole, and the operator pulls it out and puts it in the next. I would say the number of shells that would fly out of the hole would be fifteen or twenty per cent.

Mr. Millhouse: Did I understand you in your paper to say the shell hole is not drilled the length of the cut?

Mr. Jenkins: You drill it within six inches from the end of the undercut. The projection from the bottom of the hole itself is six inches in front of the undercut.

Mr. Millhouse: Is the shell pushed to the back of the hole?

Mr. Jenkins: It is, and then pulled back an additional six inches, so that the nose of the shell itself is really about one foot from the undercut.

Mr. Millhouse: Do you allow the compressor to stay in the room while the shell is being discharged?

Mr. Jenkins: The compressor stays within fifty feet of the place of the shooting. The compressor is equipped with a guard, or shield, which protects the operator from the shell flying. We have never had it come back to the compressor when it is fifty feet from the face.

Mr. Millhouse: I want to say that recently I saw a demonstration of that at the Royalton Mine, and they would stay in the same room where the shell was shot.

Mr. Jenkins: We have the same practice here.

A Voice: How long does it take to charge a shell?

Mr. Jenkins: A minute and a half to two minutes and a half, depending upon the pressure you desire to put in the shell.

President Treadwell: In pulling your shell out six inches, does it throw the coal out better from the face?

Mr. Jenkins: It appears to send it out a little more than the powder does.

Mr. B. H. Schull: Are you using one hundred per cent air shells in the mine, in shooting the entire mine?

Mr. Jenkins: No, we are shooting two units, and they are composed of Airdox one hundred per cent. We run a daily screen test on this room.

Mr. Schull: The question I wanted to bring out is, do you take screen tests?

Mr. Jenkins: We keep a daily screen test on this territory.

Mr. Schull: Then you know the difference between your screen powder shot and air?

Mr. Jenkins: Yes, sir.

Mr. Schull: That is the question I wanted to ask.

A Voice: How does the loading machine operate compared with air shooting as it would with powder shooting?

Mr. Jenkins: When we first began loading the Airdox coal we experienced a lot of difficulty, and the tonnage went down. Since that time we have become more proficient in the shooting, and the tonnage is up where it was with the other shooting. We went through a period of two or three months where the tonnage was down ten per cent or fifteen per cent, but that has been overcome now. The loading has to be gone at in a little different way than when it is powder shot. After the operator becomes accustomed to handling the larger amounts, it seems he has no difficulty.

Mr. James White: I would like to ask Mr. Jenkins how many holes he gets with a shell.

Mr. Jenkins: I do not understand your question. The same shell is used to shoot all the holes.

Mr. White: How many shots do you get with one shell?

Mr. Jenkins: You mean before the shell breaks down?

Mr. White: Yes.

Mr. Jenkins: That would vary

ıere from one hundred to maybe
n hundred before the shell is
ed.

. White: When the shell flies
f the hole six or seven feet, what
: does it have on your copper
g?

. Jenkins: There is a small pig-
there is a short tubing on the
and this is the part which is
nto the line. When this shell
out, any break in the copper
g usually takes place in that
l. We carry a bunch of extra
ls on the machine, and just sub-
e a new one for the broken one
keep on going. We repair it
by cutting off about six inches
utting it back into service.

airman Hamilton: Any other
ons? Mr. Johnston, have you
ing to add on this subject?

. J. M. Johnston: I think not.

airman Hamilton: Mr. Taylor,
ou say something on it?

. H. H. Taylor, Jr.: I do not
e I have anything to say, thank

airman Hamilton: Mr. Sandoe?

C. J. Sandoe: I think the sub-
has been pretty well covered.
we use Airdox and Cardox
it is just a question of judg-
as to which serves you best,
type of coal you are shooting,
vhat the labor is. I think the
is well given. I want to com-
nt Mr. Jenkins.

airman Hamilton: Luncheon
e served in the room across the
and you are urgently requested
there promptly at 12:30 o'clock.
have a surprise for you in the
f a speaker, and outside of the
alatable food that will be there,
sure you will all enjoy the re-
after the luncheon. But in
that the afternoon session may
romptly, they ask that you be
there at 12:30 o'clock sharp.

It is rather paradoxical to say that a coal mine without coal is a failure, and we are in rather the same position in regard to progress in our Institute, because it would be almost a failure if we did not hear from Dr. Leighton. Dr. Leighton has a paper this morning on the "Developments in Our Coal Research Program," and it gives me great pleasure to present Dr. Leighton.

Dr. M. M. Leighton (Chief, State Geological Survey, Urbana): Members of the Institute and Friends, I am sure it would be ungracious of me if I were not to express my very deep appreciation of the action that was taken here this morning in endorsing the construction of the proposed State Resources Building, which is to house the State Geological Survey and the State Natural History Survey. You might like to have a word of further explanation.

In view of the fact that these scientific divisions are dealing primarily with the resources of the State and their development, the Natural History Survey dealing with the biological aspect, with the agricultural problems, problems in horticulture and so on, and the Geological Survey dealing with earth materials and mineral substances, it seems especially appropriate that there should be a building in the state to house this research work having to do with the improvement of the products and the finding of new uses for the state's fundamental resources.

I want to thank the Institute for the action that was taken, and I think you can imagine that it warms my heart a good deal to have this action taken. I cannot help but feel, however, that you perhaps took a little hasty action in view of the fact you did so before I presented my paper.

In other words, the jury acted and acquitted the criminal without hearing from him.

May I also call your attention to the display of some of our research work on coal out in the corridor on this floor? You will find there illustrated some of the things I shall mention in this paper. And tomorrow those of you who come to Urbana to attend the Game, if you have opportunity to come around through the laboratories, will find there a very hearty welcome. We would be glad to take up any matters with you that you would like to discuss or to show you any part of our work that is in progress. If you were to come there you would find a situation that from some angles you would not be proud of. For example, you will find that some of our work and some of our valuable records must be done and kept in a little old house that is a fire hazard. The fine equipment that is there has no place in such a building. Indeed, you would also find, for example, that the need for additional space has meant the moving of some offices out into the garage, the taking out of some of the cars and building temporary offices in our garage back of our laboratories. So the situation is very acute with regard to the need of appropriate and adequate facilities for the carrying on of this work on the state's natural resources.

DEVELOPMENTS IN OUR COAL RESEARCH PROGRAM

By DR. M. M. LEIGHTON
Chief, Illinois State Geological Survey, Urbana, Ill.

Someone has said, "Tell me what your resources are and I shall tell you what your society is."

The more we ponder this statement the more we become impressed with its force. Our minds immediately reflect upon those regions which differ in their resources of basic materials, of geographic location, of topography, of climate, and of human talent and skill. We recall those regions which have much, and those which have little. We picture their wealth and their poverty; their attraction for men of ability on the one hand, or men who are content to live on small margins on the other hand; their high development of all of those features which make for a progressive type of civilization with ready means of extraction and conversion of resources into energy, construction, transportation, communication, educational facilities, and human character, or the lack of such development which keeps mankind in the primitive state. It is indeed true that the sum total of the resources of a region determine the state of society existing there.

But upon second thought, we remind ourselves that a society may cease to progress. It may become static, it may retrograde. This is likely, especially if the individuals which make up that society are content with conditions as they are, if they feel that no new knowledge lies

and no new and better ways of
plishment. Instead, therefore,
ying, "Tell me what your re-
s are and I shall tell you what
society is," it is desirable that
dopt another more dynamic
of view, namely, "Tell me what
e done with your resources and
tell you what your society can
e."

s viewpoint became the cardinal
ple of the new program of the
Geological Survey three years
when with the aid and enthusi-
interest of the Illinois Mining
ite, a series of investigations
naugurated on the coals of the
of Illinois and the other re-
s of this area.

w that these researches have
under way for three years, it
pertinent that we should
the contributions that have
made and make a report of
ess. I shall, therefore, proceed
this, with the feeling that you
h your enthusiasm of spirit
our sympathetic support, have
pated in the work, and helped
ke possible the results thus far
ed.

phasis has been laid upon
l lines of inquiry.

The nature of coal.

The distribution of ingredi-
n fine coal with regard to their
bility and the production of
ly adapted fuels.

The conversion of slack coal
marketable product.

The coking characteristics of
coal as a basis for satisfactory
esign and operation.

The classification of Illinois
ased on their composition, heat
and properties.

The competitive position of
coals with special reference to
gas and fuel oil.

Every line of investigation has yielded new knowledge, has given new visions as to what can be done with our coal resources, and has opened wider the doors of opportunity for the future.

1. The present lack of knowledge regarding the nature of coal is most serious. Upon the attainment of this knowledge rests the richest chances for a wider, more efficient, and new utilization. Without such knowledge any piece of experimentation is likely to be a shot in the dark.

The first step upward in the ladder of success has been, we believe, in finding the proper lines of approach, namely, the study of the four banded ingredients, or constituents, of coal—clarain, vitrain, durain and fusain. The physical and chemical composition and properties of these are being determined, including the nature of component plant parts and plant accretions such as waxes and resins. Such knowledge is fundamental to an understanding of the nature of the individual ingredients and of the coal as a whole and provides a rational basis for experiments in preparation and utilization.

You will doubtless recall that the samples for these studies are obtained in an entirely different way from the usual method of collecting a face sample for chemical analysis. Complete vertical columns of the entire coal bed, from the roof to the floor, are obtained and taken to the laboratory, with each piece labeled as to its precise position in the coal bed. Thus far, twenty-eight such columns have been taken from the No. 6 coal bed in 10 representative counties over the State, 5 from No. 5 coal, 3 from No. 2 coal, and 1 from No. 1 coal. The data obtained by this study show that there is a definite increase in the amount of vitrain in the No. 6 seam from the northwest to the southeast, and that there are local variations in amount of fusain which, of course, influence the character of the coal.

Financial aid has been obtained from the National Research Council for a study of the plant components in the coal beds. As knowledge improves, coal can be more accurately classified with respect to the contents of the plant components, and the distinctions between types of coal will have increasing significance in utilization.

The study of the mineral composition of the coal is also well under way. It was necessary to pioneer in the development of the technique of this new study because such research is new. The separable mineral particles must first be isolated, in successive small sections of the vertical column, and then identified as to mineral species under the polarizing microscope by a highly trained specialist. The information gained is very useful in the understanding of ash behavior in combustion, in problems of selective mining, and in coal cleaning. Harvard University has thought sufficiently well of the work done thus far to accept the work of our investigator as a doctor's thesis.

It is thus seen that both the organic and mineral constituents of the coal beds will be eventually known, their effect upon the use of the coal will be learned, and how to alter the coal for different uses will be determined.

2. The investigation of the distribution of the banded ingredients in the various fractions obtained by float-and-sink methods, and the calorific value of each fraction, has been initiated and further investigations will probably be carried out as a cooperative project between the State Geological Survey and the Department of Mining and Metallurgical Engineering. A preliminary study shows that there is a concentration of the vitrain in the lighter fractions, and fusain in the dust. These differences suggest the possible desirability of selective preparation for specific uses. Studies in the calorific value of float-and-sink fractions have demonstrated the fallacy of the former concept that coal is a single substance diluted by ash, have shown the significance of such information in maintaining uniformity of output of a cleaning plant with respect to heat value of the product, and provide a means of determining the practicability of producing coal of certain standard calorific quality. Some preliminary basic data have just been pubished in the Survey's Report of Investigations No. 34, on "Banded Ingredients of No. 6 Coal and Their Heating Values as Related to Washability Characteristics."

3. The investigation of the physical properties of coal under three variables—temperature, pressure, and time—had already led last year to the discovery of a method of briquetting fine coal by impact without an artificial binder, and this year the discovery was made of a method of making smokeless briquets, that is, briquets which give off only about one-fifth as much smoke as Pocahontas coal. This development, it appears, could not have taken place except by employing the impact method and by using no artificial binder. A report is now in preparation which will give the details of the process. Requests for permission to use this new process experimentally on local coals in Canada have been received from the Canadian Bureau of Mines and on coals in Utah from the University of Utah.

Work is also under way in
ning basic information, par-
rly of a chemical nature, which
as its chief objective the wiser
tion or preparation of Illinois
for domestic or metallurgical
manufacture, the design of ovens
d to Illinois coals, and the
mination of the best practice.

ring our studies on coking, it
found that the formation of
ry pieces of coke—an undesir-
characteristic of some Illinois
—could be minimized by the
ion of small amounts of fusain
e charge. The addition of a
quantity of fusain, to these
y swelling coals resulted in a
ier coke of greater strength.
dust removed by mines by the
sting process, in the preparation
oker fuel, offers a convenient
e of fusain. A report on this
will soon be issued.

The Classification of Illinois
has also been given attention.
adoption by the American
ty for Testing Materials of ten-
specifications for the classifi-
of coals by rank and by grade,
the pressing need of accurate
fication under code regulation,
made desirable the immediate
cation of a bulletin on this sub-
n which is being assembled all
le information provided by
us public bureaus in regard to
chemical character of Illinois
as that is commonly understood.
desirable to have the informa-
so presented that the domestic
mer as well as the dealer and
cer may be able to estimate
t great difficulty the relative
of coals offered at different
particularly the extent to
the value is affected by
ic value and ash content.

The last compilation of analyses was printed in 1923 and since that time, particularly in the last four years, a considerable number of mines have been sampled in areas previously not represented. Furthermore, the compilation of 1923 contains analyses of a considerable number of car and tipple samples not so indicated. There is additional reason for this new compilation in the need for having values expressed on the basis (moist mineral-matter-free basis) recommended by the Committee on Coal Classification of the American Society for Testing Materials.

The new bulletin will provide standard analytical information in regard to the regional variations in Illinois coals, will classify Illinois coals according to rank and grade, and will give information that will enable the domestic user to determine the approximate relative value of coals in a market which, like the present, is considerably askew with respect to prices. It will, therefore, be a contribution toward the eventual realization of a rational basis for evaluating coals.

The bulletin will contain among other data the following tabulations:

(1) A tabulation of approximately 1,000 individual proximate analyses of face samples on an "as received," moisture-free, and ash and moisture-free basis, with calorific values and sulfur values on each basis and with calorific values on a unit coal basis.

(2) A tabulation of mine and county averages of 263 mines on an "as received," dry, ash-and-moisture free, moist mineral-matter-free and dry mineral-matter-free (unit coal) basis showing proximate values for each mine and ultimate values where available. Moisture, volatile matter, and fixed carbon values will be shown

on a moist mineral-matter-free basis, and volatile matter and fixed carbon values on a dry mineral-matter-free basis (unit coal).

(3) A tabulation giving county average values in alphabetical order by county and seam. This will be a revision of the table in Bulletin 56, edition of 1932.

(4) Available data on ash-softening temperature and the occurrence of organic and pyritic sulfur will also be given.

(5) Available data on agglutinating and slacking tendencies of Illinois coals will be provided.

6. Mineral Economics Investigations. The use of minerals and mineral products in present day industrial production is so intimately interwoven with the entire industrial fabric that investigations in economic problems of the mineral industry for the benefit of Illinois mineral industries and as a guide to the selection of our research projects, necessitate broad inquiries in the related fields of manufacturing, transportation, and agriculture. Furthermore, the position of Illinois as the major mineral producing state of the Upper Mississippi Valley and also the chief source of manufactured goods for these states necessitate an extension of economic inquiries into the conditions, trends, and developments of this entire economic and geographic unit. Such studies have been energetically pursued.

The manuscript for a complete detailed report on the competitive position of Illinois coal in the Illinois coal market area, with special reference to natural gas and fuel oil, is approaching completion. This will be of great interest to operators and sales agents in analyzing the problem of coal competition and the status of the various market areas, on the basis of which sound future policies can be shaped by the coal industry.

The importation of natural gas from 1929 to 1932 has increased 177-fold, from 156,000,000 cubic feet for 1929 to 27,675,000,000 cubic feet for 1932. This represents a replacement of 1,107,000 tons of bituminous coal, for both domestic and industrial uses, the future significance of which to the Illinois coal industry, the cities and towns dependent upon this industry, the railroads and their employes, the investments in all of these properties, and the support of the schools and local government cannot be fully appreciated by the average citizen. The need for pressing on toward the goal of a wider and more efficient utilization of this, the greatest of the state's resources, is nothing short of imperative. This requires more incisive inquiry into the fundamental nature and behavior of Illinois coal, to secure the necessary information by which the present methods of coal utilization can be revolutionized and made to meet the competitive advantages now possessed by imported natural gas.

I am sure that you are all aware of the fact that the accomplishments herein described are due largely to the plan of group research, put into effect in 1931. In the operation of this plan, there is a joining of hands of the geologists, chemists, physicists, microscopists and mineral economists.

Chairman Hamilton: The report of Dr. Leighton as to his projects might possibly create in your minds some line of endeavor which you think the Institute or department could naturally follow. I feel quite sure the Doctor would heartily welcome some suggestions as to other lines of endeavor in order to follow and fill out a full program.

hink you can speak very freely : it, and I feel quite sure the or would appreciate it.

there something to be offered · this line?

. Leighton: Mr. Chairman, may hasize that suggestion of yours? hold ourselves in a receptive as to the directions that our rch should follow in order that y be of the greatest help to the tries of the State. We solicit thought along these lines, in the that by putting our heads tor more can be done than if the ers of our Staff are to proceed ding to their own ideas.

w, if you have any suggestions morning they will be most wel- . Or if, when you visit our atories, any thoughts come to nd you have any suggestions to , be assured that is exactly what ould like to have, and that is eason why we want you to come r laboratories.

airman Hamilton: Thank you, or, for verifying my idea. Now, ave heard the direct invitation sit the laboratory tomorrow. It t out of place to add that our efficient and ready Secretary has some tickets to the football which might be an added inment to go to Champaign toow.

rlier in the proceedings this ing there was a request made by President for a report from the man of the Essay Committee. as engaged in another function, eve, at that time, but has since d, and I would ask Mr. Weir to upon that at this time, if he is

Paul Weir: (Essay Contest ittee): Mr. Chairman, your ttee reports progress. It did el that the time available between the opening of school and the date of this meeting was sufficient to cover the ground and get the school children properly interested in the preparation of these essays. After discussion with the other members of the committee and the Secretary of the Institute, it was decided in view of the short time available we would postpone the contest until after the first of the year, and will be in a position to report at the Spring meeting.

Chairman Hamilton: Gentlemen, you have heard the report of the Committee Chairman. What is your pleasure?

A Voice: I move that the report be accepted.

(Which said motion was duly seconded and unanimously adopted.)

Mr. Peter Joyce: In order to disabuse Dr. Leighton's mind that we acted rather hastily on the adoption of Mr. Thomas' motion and his subsequent motion, I move that we extend to Dr. Leighton a rising vote of thanks for his splendid paper here this morning.

(Which said motion was duly seconded.)

Chairman Hamilton: You have heard the motion.

(Whereupon said motion was adopted.)

Chairman Hamilton: I think that was a very happy suggestion.

Mr. Fred S. Pfahler: I want to drop back to the report of our Membership Committee. I think it is hardly fair to pass that by with a mere gesture. About a year ago when our worthy President Harry said he hoped we would build our membership up to five hundred, I believe most of us thought it was merely a dream and, perhaps in the face of the times, impossible. About a month ago I happened to be at a luncheon at which our worthy Secretary was present, and he made the statement we were only short seven of the five hundred.

I do not know who the members of the Committee were, but I think they have done a wonderful job. I often feel this: that as we increase in number we command more respect and are more powerful.

While I do not know our incoming President personally, I have it on good authority he is very energetic and capable, and with such help as that committee gave our worthy President Harry, the same help to Mr. Sandoe, our incoming President, will likewise continue to build our Institute.

I think a motion would be in order, Mr. Chairman, to accept the report—I do not believe that motion was made—to accept the report of that Membership Committee, and let the record show what they accomplished. And I so move.

Chairman Hamilton: It will afford the Chair a great pleasure to see that Mr. Pfahler meets the incoming President after luncheon. Now, I think it is proper that a rising vote be given Mr. H. H. Taylor and his committee for their splendid work during the past year. All those in favor will please arise.

(Which said motion was duly seconded and unanimously adopted.)

Chairman Hamilton: It is now just 12:00 o'clock, which gives us about thirty minutes to attend to a few little matters before we meet for luncheon. Consequently, I turn the meeting back to the President.

President Treadwell: Gentlemen, I believe that is all there is to come before your meeting this morning. We will stand adjourned until 2:00 o'clock. Please remember, luncheon promptly at 12:30 o'clock.

(Whereupon a recess was taken until 2:00 o'clock of the same day.)

AFTERNOON SESSION

2:00 O'clock P. M.

President Treadwell: I will call the afternoon session to order. We have the pleasure this afternoon of having a gentleman as Chairman who has been very active in the last few years in the Institute, and particularly active this year. It gives me a great deal of pleasure to turn the meeting over at this time to Mr. Thomas, who will act as Chairman.

Mr. T. J. Thomas: The first paper to be delivered this afternoon is to be presented by a man for whom I have a great deal of admiration. I have known him for a good many years. We have called upon him a number of times to help us with some difficult problems we have been obliged to meet.

It gives me pleasure to introduce to this body this afternoon Mr. Charles A. Herbert, Supervising Engineer of the Department of the Interior, Bureau of Mines, of Vincennes, Indiana, who will talk to you on the "Opportunities Available to Management and Employes Through the United States Bureau of Mines for the Prevention of Accidents." Mr. Herbert.

Mr. Charles A. Herbert: Mr. Chairman and gentlemen of the Illinois Mining Institute, the paper I am going to read I had mimeographed, and I prepared about one hundred and fifty copies. I did not have this paper mimeographed because I thought you would all want copies of it or anything like that, but in a great many meetings of this kind it is the practice to have the papers mimeographed, and that is the reason this paper was so prepared.

PPORTUNITIES FOR ACCIDENT PREVENTION AVAILABLE TO MINE MANAGEMENT AND EMPLOYEES THROUGH THE UNITED STATES BUREAU OF MINES — AN ACCIDENT-PREVENTION PROGRAM

By C. A. HERBERT
vising Engineer, U. S. Bureau of Mines Safety Station, Vincennes, Ind.

accident-prevention program
ed in this paper is based on the
se that a majority of all mine
nts are preventable and in most
are due to careless and dan-
practices and conditions that,
ile, detract from efficient oper-
of the mine and may well be
ated. That this is not a mis-
premise has been amply proved
nes where accidents have been
d materially if not to the mini-

claim is made that this pro-
or plan is the only satisfactory
bring about a reduction of
nts; it is claimed, however, that
a workable program, and if
ly and intelligently carried out
or in entirety will bring about
ctory results.

THE PROGRAM

Study of Accident Records and Reports

iously, if accidents are to be
ted, some knowledge must be
to what is causing them and
getting hurt, in order that in-
nt steps may be taken to pre-
their recurrence. Therefore,
nary to beginning a safety
m in which the Bureau's as-
e has been requested, the
engineer first studies the ac-
records and reports, usually
ing the accidents according to cause and occupation, if this is not already being done by the operator. The study of these reports and tabulations gives a picture of how and where most of the accidents occur. The completeness of this picture depends on the type of report required by the company. Unfortunately the accident reports and records of many (probably of most) companies are very meager in so far as details of the actual cause of the accident are concerned. The cause of the injury (fall of rock, run over by cars, etc.) is given, but little or nothing is said regarding the contributing factors leading up to the accident, information of a type absolutely necessary if steps are to be taken to prevent similar accidents in the future.

2. Safety Inspection

After reviewing the accident reports and obtaining a more or less complete picture of the type of accidents and the labor classification experiencing the majority of the accidents, a safety inspection is made of the mine to gain first-hand information on operating conditions and practices. A study of the accident reports assists the Bureau engineer in making the inspection, as it gives him an idea of the hazards to be expected. The safety inspection includes a check on the ventilation by taking air measurements and mine-air samples, and a study of the coal-dust explosion hazard, including the taking of dust samples.

A copy of the report of this inspection calling attention to any unsafe conditions or practices observed is usually sent to the operator.

3. Accident-Prevention Course for Officials

After the inspection of the mine is completed a series of meetings is held with the mine officials, usually once each week, at which the cause and means of preventing the various types of mine accidents, such as falls of roof and coal, haulage accidents, etc., are discussed. The average mine official is concerned primarily in getting the maximum production possible per man and machine and as a rule has not given very much personal thought to the question of safety, although the coal company may have instituted some sort of safety, organization or even may have employed a safety man. This series of meetings brings home to the mine officials their responsibility in regard to accidents and the fact that dangerous conditions and practices that have been permitted to exist are not necessary to obtain maximum production at the least cost.

The desired changes in practice that will bring about greater safety are put into effect as the meetings go on, so that as a rule the accident record is noticeably improved by the time the course is finished. In substance, a set of safe operating rules or standards covering the various phases of mine operation is developed and put into practice by the officials.

Any safety program is necessarily one of education. The men who are being injured must be educated and trained to do their work in the safe way, which after all is the best and most efficient way, and the mine officials who are in daily contact with the men must assume the responsibility for their education and training. However, before they can ever hope to sell the idea of safety to the men in their charge they must first be sold the idea themselves.

4. First-Aid Training

The Bureau of Mines has been training men in first-aid for a number of years, and the Illinois State Department of Mines and Minerals has been giving similar training. At first this training was given solely by Bureau or State instructors to a limited number of employees at each mine. Later, in 1926, a new plan of first-aid training was inaugurated in cooperation with the State Department of Mines to give a greater number of employees the benefits of this training. This plan consists of giving enough additional training to certain selected employees to enable them to act as instructors under the supervision or guidance of the State or Bureau instructor. This plan has operated very satisfactorily, and by this means it is possible to train all the employees at a mine in a comparatively short time. This is the plan under which most of the Bureau's first-aid training is now given throughout the United States.

First-aid training not only gives the men knowledge of what to do in electric shock, arterial bleeding, or other severe injury, but it also plays an important part in any safety program. It gives the employee the feeling that he personally is taking an active part in the program; while taking the training he absorbs accident-prevention ideas and speculates on the needless occurrence of accidents as well as on available means

oiding them. At the same time,
ts him in a receptive frame of
which makes it much easier for
ine official to impress him with
ought that new safety rules that
be put into effect are for his
welfare or that of his fellow
yees and should be obeyed.

st-aid training may be carried
the same time or following the
of the accident-prevention
e to the officials.

5. Holmes Safety Chapters

be entirely successful, any
program must have the con-
l support and cooperation of the
yees. It is believed that in
instances this can be ac-
ished best by the establishment
aintenance of a safety organi-
for employees—the organi-
to hold monthly meetings at
accidents that have occurred
the past month may be dis-
and suggestions encouraged
the men as to how they might
been prevented or can be
d in the future. Entertain-
of some sort, or speakers,
y are provided for each meet-
At nearly every mine there is
musical or other talent that can
ilized. To encourage attend-
draw prizes, consisting of
shoes, safety hats, or clothing,
rnished by the operator at many
gs of this character.

se meetings, at which the men
fficials meet in a friendly and
ative spirit, have done much to
e contract relations between
mpany and the local miners'
zation.

hapter of the Holmes Safety
tion offers a workable set-up
h a safety organization. The
Safety Association is sponsor-
the United States Bureau of Mines and in several states has the endorsement of the United Mine Workers of America. At present there are about 340 chapters of this organization in the mining fields of the United States.

Safety posters, as well as some scheme to promote rivalry between the various foremen in the mine, between sections of the mine, or between mines of the same company or of a definite mining region are useful and generally productive adjuncts to any safety program.

One company in Indiana has devised a "Thermometer of Accidents" on which is shown monthly the individual records of the bosses or foremen. A sketch of this thermometer board is attached (fig. 1). This company has erected a flag pole at both mines and the mine having the lowest accident rate for the month is privileged to fly the flag for the succeeding month.

In talking to the mine operator in regard to starting a safety program at his operations, certain questions usually arise, some of which possibly have occurred to you. Some of these questions are given here, together with a suitable reply.

Question. What will this safety program cost our company?

Answer. Very little in the way of money, but much time, hard work and hard thinking on the part of every official connected with the company. The results obtained will be in direct relation to the effort put forth. If you are not altogether convinced that such a program is worth while, or are mentally or physically lazy, it probably would be best not to attempt such a program, as the results would undoubtedly be disappointing.

Question. Will the men go along with such a program?

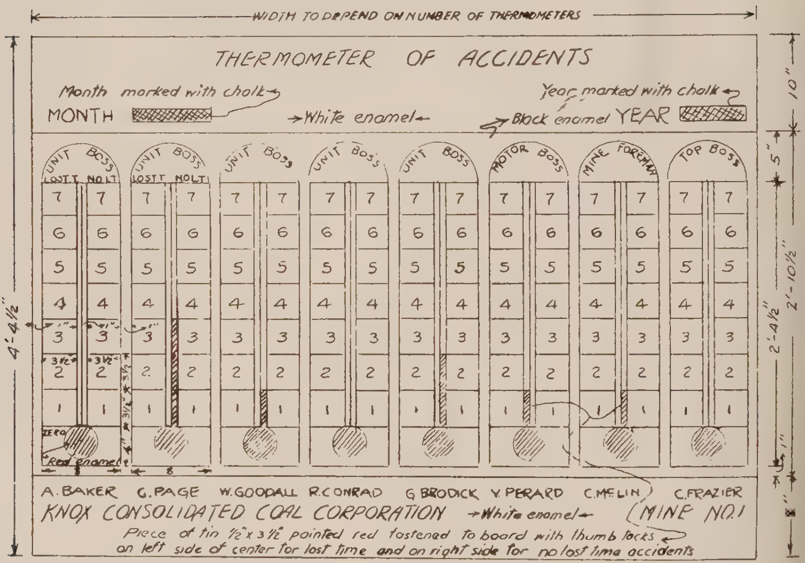


Figure 1

Answer. Yes, if you are in earnest and show them that you are sincere and are not inclined to pass the "buck" to the men; in other words, safety in mining requires co-operative effort, with no holding back by either employer or employee.

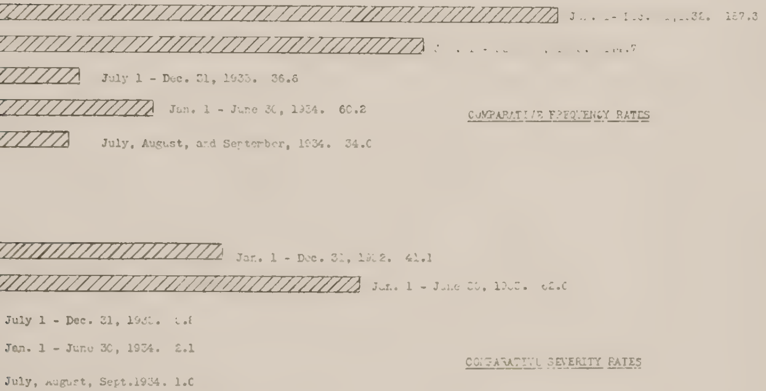
Question. How much assistance may we expect from the Bureau of Mines in putting such a safety program into effect?

Answer. The Bureau will give all the help possible with the limited personnel available. It will make the safety inspection of your mine; conduct the class in accident prevention for officials; assist with the first-aid training; and help to organize and to some extent maintain a chapter of the Holmes Safety Association. The Bureau enjoys the cooperation of the Illinois Department of Mines and Minerals and without question you may count on the assistance of Mr. James McSherry and his department. However, we wish again to emphasize the fact that the burden of making any safety work or safety program a success rests almost solely upon the shoulders of the mine officials and mine bosses. Although the State Department of Mines or the Bureau of Mines doubtless can be of assistance, unless the mine officials themselves take and keep the lead the results will be disappointing.

Question. Has a similar safety program been tried in this field, and what have been the results?

Answer. A number of operating companies in Indiana and Illinois, as well as in numerous other states, have put this or a similar program into effect either in part or in entirety and the results have been satisfactory. No attempt will be made to go into details as to the results obtained by these various companies, but instead one company —the Knox Consolidated Coal Co., Bicknell, Ind.—will be cited as an mple. This particular company chosen because, prior to be- ning their safety campaign they a very unfavorable safety record the results obtained are there- much more striking than if they had a fairly good record at the inning; second, they put the entire gram into effect.

n spite of the fact that for years mines of the Knox Consolidated Coal Co. have been recognized as examples of well operated and managed mines, the accident rate at these mines has been decidedly unfavorable. This was particularly true during 1932, and it was because of the 1932 record and that of the early part of 1933 that decisive steps were taken by the management to bring about an improvement. The results of their efforts are clearly depicted in the accompanying figs. 2 and 3.



KNOX CONSOLIDATED COAL CO., No. 1 MINE, BICKNELL, INDIANA.

Figure 2

he accident-frequency rate at 1 mine was reduced from 187.3 1932 to an average of 43.6 for 15-month period, July 1, 1933, eptember 30, 1934. The accident- rity rate for this mine was re- d from 41.1 for 1932 and 62.6 the first half of 1933 to an age of 1.3 for the same 15-month d.

their No. 2 mine the frequency was reduced from 137.7 for to an average of 30.9 for the onth period, July 1, 1933, to mber 30, 1934. The severity at this mine was reduced from 26.0 for 1932 to an average of 1.7 for the 15-month period, July 1, 1933, to September 30, 1934.

The accident-frequency rate is the number of lost-time accidents per million man-hours of exposure.

The accident-severity rate is the number of days lost as a result of accidents per thousand man-hours of exposure.

A lost-time accident is one in which the injured is unable to report to work on the day following the injury.

In computing the severity rate, a fatality or permanent total disability was given the standard valuation of

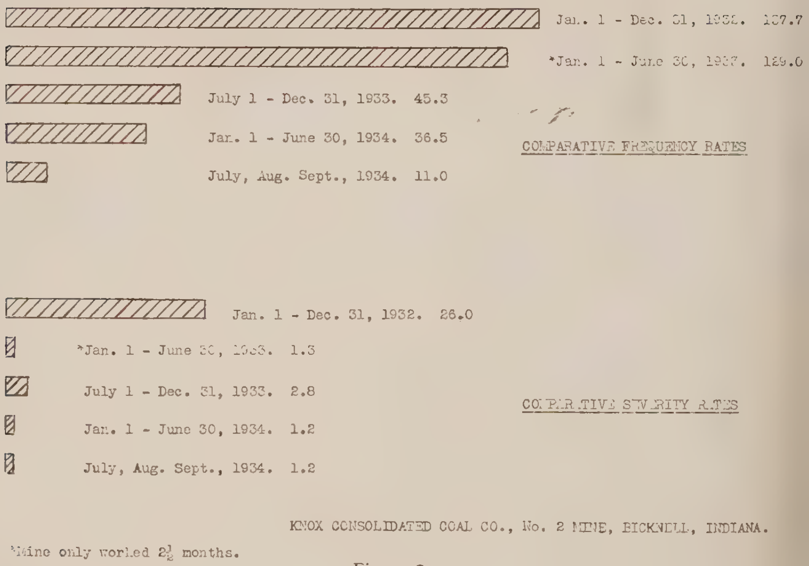


Figure 3

6,000 days, while in all other lost-time accidents the full period of disability was assessed against the mine, irrespective of the number of days the mine may have worked during the disability period.

The reduction in severity rates at these two mines is a very good indication of the reduction in compensation costs. It is very doubtful whether the equivalent amount of effort on the part of the officials toward the reduction of operating costs in these or other well-operated mines or in any other phase of mine operation could have equaled the savings made through their safety work. In addition, there is the very great satisfaction of having prevented loss of life and crippling of workmen.

The following is quoted from the closing paragraphs of a paper entitled "Can Coal-Mine Accidents Be Prevented" delivered by P. G. Conrad, superintendent of the Knox Consolidated Coal Co., before the Indiana Coal Mining Institute in June.

"Since this campaign our mines are in better physical condition than ever before in our mining experience. We find that what we have done, in making our mines a safer place to work for our employees, has not increased our cost a fraction of a cent per ton. On the contrary, we have found that it lowers the cost, due to increased efficiency and better co-operation of our employees, to say nothing of the greatest saving of all—that of human life and limb. As a result of our efforts and the co-operation of our employees we have reduced the accident-frequency and severity rates at our mines more than 75 per cent.

I am sure that anything that we have done, you can also do. From the results and experience of this campaign, I can say without hesitancy, accidents in coal mines can be prevented."

I do not know whether I have made myself clear or not in this paper, but

thing I do want to say, the
au of Mines does not take any
t for the reduction in accidents
ese miners. Not only in Indiana
ll over the country we have in
places done exactly as much
in helping the company as we
with this particular company,
here has not been a dent made
ir accident record. It all hinges
and depends entirely upon the
als in the mines whether or not
accident rate will be improved.

hank you.

airman Thomas: Mr. Herbert,
half of the Illinois Mining Insti-
I want to thank you for this
interesting paper, so ably de-
d. I am sure what Mr. Herbert
ad to say should invoke some
ioning from the body. If you
ask Mr. Herbert any questions
nay desire, I am sure he will
take to answer them to the best
ability. Is Mr. Lyons here, of
ell & Zoller Company?

John Lyons: Yes, sir.

airman Thomas: Haven't you
hing to say in this matter?

John Lyons: I might say, Mr.
man, that I thoroughly endorse
erbert's system here. We have
practical experience in trying
cally everything which Mr. Her-
mentioned. For instance, we
d back in 1929, and started first
our accident record, keeping an
nt record and report, and have
used the Bureau of Mines'
d of standard charges which
erbert has mentioned, that of
ing three days, which is the
rd charge of loss of a finger,
ix thousand days on a total dis-
or fatality, and we have used
figures all the way through the
ive years in compiling our ac-
record. These figures have shown us whether we were going up or down.

We first had an inspection by the Bureau of Mines Engineers, and they showed us several things we were doing wrong, and they gave us some information on just what in their opinion should be done to correct these things. We took a lot of advice from them. They did a lot of work for us all the way through the years, and have helped us any time we called upon them.

We have also adopted, as Mr. Herbert mentioned, a few of the safety rules and standards to avoid similar accidents. The keeping up of these is one of the greatest things, I think, in keeping down the accidents in any mine.

We have taken also the First Aid Training. We have had two attempts at that. Back in 1930 we had about 1435 of our men put through the First Aid course, and also this last spring we took First Aid Training at both of our Zéigler mines, and put the thing over 100%.

This in itself, of course, is a very good place to talk safety. We have a chance to talk to the men. Of course, they will come back and tell you a lot of things, which you do not always do, but it gives them a chance to voice their grievances and you get a lot of good thoughts out of that.

On the safety courses and on the safety chapter, we haven't done anything on that. We have used the safety posters and safety contests each year, which in my opinion has helped us very much.

We have one mine which is a very bad mine, our No. 1 Mine. If you will pardon me from inserting these figures—you will find them in the 1933 proceedings of the Institute, and I beg leave to insert them to show just what campaigns have done from the beginning.

This mine I am talking about now had a fatality rate of twenty to thirty, or 3.27 fatalities. The fatality was around 325,000 tons. This same mine has not had a fatal accident since the 5th of December, 1930, on the ground, and we have produced around 2,800,000 tons of coal. It shows you that a bad boy can be made good by thorough co-operation with all the safety rules and methods. We have changed the viewpoint of the bosses as well as the men on the safety work.

In 1929, this mine had a severity rate based on Mr. Herbert's figures or system he employed of 43.74. In 1930 it was reduced to 21.80. In 1931 it was 1.61, in 1932, 1.4, and in 1933, 2.08.

The same mine had a frequency rate of lost time of 330.5 in 1929. In 1930 it was reduced to 253.98, and in 1931 to 115.82, in 1933, 96.15, and in 1933 it was 74.00.

These improvements, of course, as I said, come about through the methods Mr. Herbert has suggested, and also the very excellent help and co-operation received fom the Bureau and also from the State Department of Mines and Minerals, for which we are very grateful. I thank you very much.

Chairman Thomas: Thank you very much, Mr. Lyons. I wonder if some one else hasn't something to say on this very important topic? Or if you have some questions you would like to ask Mr. Herbert? I wonder if Mr. McFadden, of the Peabody Coal Company, would care to say a word.

Mr. George C. McFadden: I only have a question to ask, Mr. Chairman. I think everyone connected with the mining industry in Illinois will readily admit and concede the wonderful aid and assistance that is always available through the Bureau of Mines and the help they have always given us.

In Mr. Herbert's paper, in one of his answers to one of the questions, he stated the Bureau will give all the aid possible with the limited personnel available. I am just wondering what Mr. Herbert meant by that statement, and whether this Institute could, if they have limited force to do anything, help his organization to give better assistance to the District in which they serve. That is the only question I have. It seems to me possibly the Institute might be able to give some asssitance. It is unfortunate indeed that Mr. Herbert's bosses—I say bosses because the Director is the boss of the Bureau—could not be here today to see this assembly and to have heard this wonderful paper as presented by Mr. Herbert.

Mr. Charles A. Herbert: Mr. McFadden, in answering your question, one of the reasons our personnel is very limited in this District is the fact that over one-third of our employes were discharged because of lack of appropriations. They were discharged a year ago the first of July.

Another reason is that, as you can probably understand, with the limited personnel for the entire country, and with the demands being made on the Bureau from various sections, we are inclined to follow the path of least resistance and move the men from the field where the least holler is being made into the field where the operators or the industry are hollering most for help. I suspect that if the operators in this field had been a little more insistent in their demands on our Washington office we would have a little larger share of the personnel in this field.

es that answer the question?
. McFadden: Yes, sir.
airman Thomas: I wonder if
Weir has anything to say on this
er?
. Paul Weir: Mr. Chairman, I
perhaps Mr. McFadden's ques-
night have embarrassed Mr. Her-
a little. He must have a feeling
ing he might say might be in
ism of the Bureau. Mr. Herbert
es to you that the personnel of
ureau has been depleted by one-
There are some other things
nnection that I would like to call
our attention. It seems to be
y much of a step-child. It was
erly under a different depart-
, and it has been transferred to
epartment of the Interior under
ew administration. It was for-
housed in the Department of
nerce Bureau, and at the present
it is spread through several dif
t structures all over the City of
ington.
e morale of the organization
as a whole, I think, is at a
low ebb. The reason given for
epletion is economy. We must
alize we have to be economical,
when human life is at stake, I
it is false economy.
ave one thing in mind which I
might illustrate the attitude of
Legislators and others towards
Bureau of Mines. Formerly the
au was able to pass out free to
s who took First Aid instruction
ll pamphlet containing First Aid
ctions. I am informed they are
onger available. Yet I think
of you who read the Chicago
ne and especially the editorial
and know the Department of
ulture publications they issued
h pamphlets as the "Love Life
ullfrogs," are somewhat amazed
e attitude which prevents the issuance of these free pamphlets on First Aid instruction.

The attitude of the average individual, it seems to me, is "Well, what can I do about it?" I think every one of you men is interested to some extent at least in coal mines, for that is where most of us make our bread and butter. There is one thing you can do about it. You can determine the attitude of the Congressmen and Senators, and try, to some extent at least, to impress upon them the necessity for adequate financial support of the Bureau of Mines.

Mr. Scott Turner resigned in July as Director. Dr. Finch, of Idaho, succeeded Mr. Turner. Dr. Finch has every desire to make the Bureau a real live one and to do the work that should be done. I know he is going to co-operate with the industry, but I think the industry itself has to become aroused and make known its wants through the representatives of the people, who of course are your Congressmen 'and your Senators. When you men have an opportunity to give them your views, do not pass it up.

To my mind, there isn't any course which has been more constructive in safety work around coal mines than the Bureau work. I do not say that because of our honored guest this afternoon, Mr. Herbert, but I have been in intimate contact with them for several years, and they do a marvelous piece of work. After all, I think one of their hardest jobs probably is to sell you and to sell me on the idea of accident prevention work. After the personnel is once sold, or after the supervisors are once sold on safety, I think the job is about 75% done. But you certainly want to be sold to the point you want it to go over so bad you can taste it, and if you cannot taste it you cannot get any place.

But I am drifting away from the Bureau of Mines. When we see the amount of money being spent everywhere by the Federal government, and then we consider on the other hand that the employes in the Bureau have been laid off and the morale of that Bureau shattered by lack of funds, and in a good many cases even though the personnel is still there the traveling expenses are not provided so that those men can get around and do the things they want to do and the things in which they believe, I think it is time for action.

The United States Bureau of Mines was established by the Federal Government at the earnest solicitation of the mining industry of the nation for the purpose of promoting safety in mining by technological research and by educational work, of assisting in the development of domestic deposits of minerals by technological research, of collecting, compiling and distributing vital statistics on production and distribution of minerals, of assisting in the conservation and proper use of natural resources and of assisting in the national defense.

The mining industry of the State of Illinois, whose mineral products averaged in value for the period 1923-1932 the sum of $186,681,000 annually, which amount is exceeded by only five of the forty-eight States, is vitally interested in furthering the work of the Bureau.

The cost to the Federal Government for the work of the Bureau has always been a very modest sum when it is considered that the Bureau serves an industry which is second only to agriculture in value of products. The appropriation of only slightly over one million dollars for 1935 has resulted in curtailment of personnel and elimination of vital work, things which are of grave concern to the mining industry of Illinois.

The Illinois Mining Institute, representing the mining industry of Illinois, in regular session in Springfield, Illinois, on this 2nd day of November, 1934, hereby records itself as alarmed at the apparent lack of recognition by the Federal Government of the importance of the work of the Bureau and of the wishes and desires and needs of the mining industry of the nation, and it further records itself as favoring the restoration of the Bureau to its former effectiveness, a thing which can be accomplished only by an annual appropriation of approximately $2,000,000.

Mr. Chairman, I would like to move that you appoint a Resolutions Committee to draft a suitable resolution in the name of the Institute which might be the means of a campaign of rehabilitating the Bureau of Mines.

(Which said motion was duly seconded.)

Chairman Thomas: Gentlemen, you have heard the motion which has been stated by Mr. Weir.

(Whereupon said motion was unanimously adopted.)

Chairman Thomas: Mr. Weir, I would like to ask you that an amendment be made to the resolution that in addition to our going on record advocating the rehabilitation of the United States Bureau of Mines, that it should be left to the Executive Committee whether they want to make a small appropriation to the work that is being done by the

ial Committee of the American
ing Congress, of which several
bers of this Institute are mem-
, leaving that entirely to the
ment of the Executive Board of
Illinois Mining Institute as to
ther they want to do that.

r. Weir: Mr. Chairman, I ac-
the amendment.

hairman Thomas: You have heard
amendment as stated.

Vhich said motion was duly
nded.)

hairman Thomas: All in favor
signify by saying aye.

Vhereupon the following motion
adopted.)

notion, it was;

ESOLVED: That the Illinois
ng Institute in regular session
rds itself as being in accord with
work now being undertaken by
Special Committee of the Ameri-
Mining Congress in the matter of
loping a plan to rehabilitate the
ed States Bureau of Mines, and
ts its Secretary-Treasurer to
to the Secretary of the Ameri-
Mining Congress, located in the
sey Building, Washington, D. C.,
ominal contribution, the amount
which is to be left to the judg-
of the Executive Committee.

E IT FURTHER RESOLVED:
a small amount of money (sub-
to the judgment of the Executive
mittee) shall be set aside to be
by the appointed committee of
Illinois Mining Institute, for the
nent of such expenses as it may
r for stenographic help, postage,
in bringing this matter to the at-
on of members of the United
es House of Representatives and
te, and other important and re-
sible Administration officers.

ILLINOIS MINING INSTITUTE.
Committee on Resolution for Rehabilitation of the United States Bureau of Mines.
T. J. Thomas, Chairman
Paul Weir
George B. Harrington

Chairman Thomas: Is there anything else—anyone else who would like to speak or ask some question on this important topic?

Mr. D. D. Wilcox: I merely arise to add to what Mr. McFadden and Mr. Weir are talking about, and do it principally with the idea of expressing our appreciation for the efforts of the Bureau of Mines, both State and National, in preventing accidents in our company. Mr. Herbert ended up his story in a way I did not quite approve of. He said the Bureau wasn't claiming any credit for that work. They should claim lots of it. They are deserving of lots of it. One of my most prized possessions which I have in my pocket at this time is a certificate of accident prevention which every member of our company must have and continue to carry with him all the time.

All of you people who are interested in mines know that most mine accidents are caused by what people feel to be a sort of predestination. The reason for that is most miners—most mining work, loading and every other part of the work, has been done the same way. Practically every man working in the mines has been taught to do that work by some other miner, who was taught to do it by some other miner, who believed accidents were a part of the operation and could not be prevented. In other words, every part of the operation has been brought to us by men who believe in accidents and that they were a part of the industry.

When these figures from the Bureau of Mines came into our place, we were compelled, not by force but by persuasion, to go into every particular of every piece of work the men did. For instance, the boss was followed from the time he left on the top until the day was finished, and every part of the work gone into. Not only the question of safety, but the necessity of the actions. It might be interesting to know that many parts of our work were entirely changed on account of the efficiency. We found there was no difference between the efficient way of doing things and the safe way to do them. I thank you.

Chairman Thomas: Thank you very much, Mr. Wilcox. I think those of you who have been in contact with the Bureau of Mines know of the great work they have done, and that Mr. Herbert is a very modest man for not taking the credit for the service they have rendered, he and his staff, to the mining industry.

Anyone else?

President Treadwell: Mr. Chairman, a year or so ago last Fall at the meeting we had the safety program up, and as Mr. Miller made some comments, it brought seriously to our attention the records we were having in our mines. For two or three months we studied carefully what they had said, and decided we had for a number of years tried to better our record and had not been successful, and it was time to try somebody else's method.

Along in the spring of the year we started on this program outlined by Mr. Herbert. We haven't got very far. We are not entirely through with our course of lectures to the management. So far as we have gone, we have got a great deal out of it. We have reduced accidents and we have increased our output per man. In other words, it does not cost us anything. We have not only reduced the accidents but have increased our efficiency.

I agree with Mr. Wilcox that the Bureau of Mines in our instance deserves a lot of credit.

Chairman Thomas: Gentlemen, the next paper we will have the privilege of hearing is by a man connected with the Battelle Memorial Institute of Columbus, Ohio. I have undertaken to discover just what the Battelle Institute is and what it stands for. It occurs to me you might be interested in knowing what I was able to develop.

Mr. Gordon Battelle created this institution as a memorial for his father, the father having made his money in the American Rolling Mill Company. The cause for the creation of this endorsement was brought about by the fact Mr. Battelle, as I understand it, was obliged to deal with a very difficult problem involving the matter of zinc during the War. As a result of that, this institution was founded. Young Mr. Battelle, Mr. Gordon Battelle, then prevailed upon his mother to leave her fortune to this institution, and later on Gordon Battelle died at some forty-seven years of age of appendicitis, and he left the residue of his fortune to this institution.

Gentlemen, the Battelle Institute has a staff of research engineers and scientists who deal entirely with the matter of coal and metallurgical problems.

It gives me great pleasure to introduce this morning Mr. Byron M. Bird, Chief Concentration Engineer, Battelle Memorial Institute, Columbus, Ohio, who will talk to you on "Fundamentals in the Design of Coal Cleaning Plants." Mr. Bird.

OME PROBLEMS IN THE DESIGN OF COAL CLEANING PLANTS

By BYRON M. BIRD

Concentration Engineer, Battelle Memorial Institute, Columbus, Ohio

Summary

The first consideration in the of a cleaning process is the lty of the cleaning problem. depends upon the quality of coal to be prepared and is not nt in the coal.

The second consideration in oice of a process is installation perating costs. If the run-of- oal is wet, these considerations wet methods. If the coal is nd can be cleaned efficiently methods, economic considera- favor wet methods for sizes about ¼ inch and dry methods ¼ inch.

If a large range of sizes is to ated in one operation, a proper ion of sizes is essential.

The tonnage of unsized feeds l per unit of cleaning capacity ls on the smallest size to be l efficiently.

A uniform tonnage of a sized lack coal can be obtained by ting the tonnage delivered to ing screen. It can also be ob- by changing the limiting size screen openings.

A dry coal for dry cleaning ses can be obtained most ad- eously by dedusting the ½ zes with hot air.

A uniform quality of coal in- some form of storage or mix- cks.

Dewatering of washed coal is ied if some intermediate sizes t with the extremely fine sizes.

The economic dividing line n centrifugal and heat drying is probably about 9-10 per cent moisture.

Introduction

In this paper I wish to deal with some problems that arise in the design of coal cleaning plants and to set up certain principles that can be used in solving them. To narrow the scope of my paper, I shall limit my remarks to the sizes ordinarily cleaned by mechanical means.

The Choice of a Cleaning Process

In the choice of a process for cleaning a given coal, the first consideration is the difficulty of the cleaning problem. This requires fundamental work of the character that Dr. Leighton and his associates have been doing for Illinois, in other words, screen analyses, float-and-sink tests of the individual sizes and visual examination of the float-and-sink products.

I wish to stress the last of these, the visual examination of the float-and-sink products, because this is not commonly made and yet it may have a very important bearing upon the cleaning problem. As far as ash content is concerned, a coal may be clean enough with a separation at 1.60 specific gravity—that is, with an ash content equal to that of the portion floating in 1.60 specific gravity—but if this separation will leave in the cleaned coal some objectional impurities from a visual standpoint, it may be necessary to clean at 1.45 specific gravity, for example, and to crush and clean the portion between 1.45 and 1.60 specific gravity. Since appearance plays such an important part in the sale of coal, I feel that visual examination of the float-and-sink products is very essential.

The specific gravity at which the given coal must be cleaned determines the difficulty of the cleaning problem. At high specific gravities, the problem is simple. At each successively lower specific gravity it becomes more difficult. In other words, no coal is inherently easy or difficult to clean. In any given case the market for the cleaned coal, and hence the specific gravity at which it must be cleaned to give the required ash content, must be known before the difficulty of the cleaning problem can be determined.

Once the specific gravity of the required separation is known, the method described in my paper, "Interpretation of Float-and-Sink Data" (Proc. Third International Conference on Bituminous Coal, 1931), will give an approximate measure of the difficulty of the separation. As copies of this paper are available to anyone who cares to write Battelle Memorial Institute, I shall not go into any details about the method except to say that I have developed a curve that can be added to any standard set of washability curves to give for each specific gravity a numerical measure of the difficulty of a cleaning problem.

Using this method I have grouped processes in the accompanying table in the range over which they are in successful commercial practice. This is only to be regarded as a rough grouping, for it is obviously impossible for me to have investigated every plant in the country.

Range of Difficulty on ± 0.10 Curve	Process
0-3	Dry Processes
0-7	Wet Processes
0-12	Wet Tables
0-20	Plunger Jigs

These figures do not mean that some process will not cover a greater range than shown. For example, we have investigated the Baum type jig on a laboratory scale at Battelle Memorial Institute and have found it to have even a greater range of application than that of the plunger type. But in general when a cleaning process is out of the range listed above, the coal company should assure itself by careful tests that the desired cleaning results are possible before installing the process.

Someone may well ask, "Why the large difference in the range of applicability of dry and wet processes; is this due to lack of development or is it inherent?" It is partially due to lack of development, for not as much fundamental study has been given to dry processes as to wet. But it is mainly inherent. Suppose, for example, we wish to separate particles of 1.50 and 1.35 specific gravities. The possibilities of a successful separation depend upon their relative specific gravities. In air; one group of particles is $\frac{1.50}{1.35}$ times as high in specific gravity as the other. In water each group is buoyed up to the extent of the specific gravity of the water, so that one is $\frac{1.50 - 1.00}{1.35 - 1.00} - \frac{.50}{.35}$ times a high in specific gravity as the other. From this it is evident that the wate separation has a great inherent advantage. However, this does no mean that some dry process may no

doing better work than a wet
cess. Factors such as the skill of
operator play too large a part
the final results secured for any
eralizations on cleaning efficiency.
thermore a very efficient dry
cess may do better work than an
ficient wet process. But, all
er things being equal, a wet pro-
will give better results than a
process.

fter the difficulty of the cleaning
lem, the next consideration in
choice of a cleaning process is the
stment and operating costs. As
as the cost of the cleaning opera-
taken by itself is concerned, a
process usually has the advantage
a dry process. Hence, if the
coming from the mine is already
, this fact favors the use of a wet
cess. But if the run-of-mine coal
ry or only slightly damp, economic
siderations favor cleaning the fine
s by dry methods. The dewater-
of coarse sizes by natural drain-
is simple and inexpensive, but
operation becomes increasingly
nsive in each successively finer
Finally a size is reached where
total cost of cleaning by a wet
ess and removing excess water
the products is greater than the
by dry cleaning methods. To say
where the dividing line between
sizes that can be more econom-
y treated by wet than by dry
ods is difficult, but it is probably
bout ¼ inch. In other words, if
dry process will give the desired
ity of clean coal with a high ef-
ncy, it will probably be econom-
on the sizes finer than about ¼
. Economic considerations on
or semi-dry coal, therefore, would
to favor a combination of wet
ning on the coarse sizes and dry
ning on the fine sizes.

Finally, there are some special considerations in the choice of a cleaning process. One of these is the percentage of "rash." This is a flaky impurity that has given a great amount of trouble in the South, and the Bureau of Mines has developed methods for its removal with the types of apparatus commonly used in that district, namely, with jigs and with wet tables. If this impurity is found in a coal, that fact constitutes a good reason for preferring those processes.

Another special consideration is clay. No one has found a really satisfactory answer to the problem of cleaning a coal containing clay, but a general principle is, as far as possible, to avoid wetting it.

Application of Process

The success or failure of any cleaning process depends in large measure upon correct application. Everyone knows, for example, that if the relative differences in specific gravity between the coal and impurities are small, he should not attempt to clean a large range of sizes in one operation. Since this principle is well known, I may pass it without discussion and go to another principle, not so generally recognized, governing the range of sizes that should be attempted in one operation.

This principle is that a proper gradation of sizes is essential. I first had my attention called to this by a friend pointing out two operations on the same coal bed, one treating 6"x0", and the other treating 3"x0", in which the 6"x0" operation was the more efficient. In fact, the 3"x0" operation was taking a heavy loss of coarse coal in the refuse. When I studied the two washeries to discover the explanation of this anomaly, I found that the essential difference between them lay in the screen analyses of the raw coal. The feed in the 6″x0″ operation had a well distributed screen analysis with plenty of 5″, 4″, 3″ and 2″ sizes, whereas the feed to the 3″x0″ operation consisted largely of 3″x2″ and 1″x0″ sizes with only a comparatively small percentage of 2″x1″ sizes. Accordingly, the logical explanation of the large loss of coarse coal in the 3″x0″ operation seemed to be that a bed of 1″x0″ sizes could not support particles of 3″x2″ coal.

Here, then, is an important principle of coal cleaning, not heretofore recognized, that applies wherever a large range of sizes is being treated. If the operation is to succeed, intermediate sizes must be present in the feed. If they are not and the mining practice cannot be modified so they will occur in the feed, it is essential to do some preliminary sizing before cleaning.

In passing, it seems reasonable that heavy media processes such as the Chance are probably less subject to this restriction than processes like jigging, which develop their beds entirely from the coal itself. I have no experimental evidence on this point, but it looks logical that the presence of a medium of relatively high density should make the exact size distribution in the coal bed of minor importance.

Another important consideration in the application of a process is the tonnage to be handled per cleaning unit. The principle involved is that capacity is determined by the smallest size to be cleaned. Take jigs as an illustration. Suppose the feed to be cleaned is 4″x0″ and it is necessary to clean the -20-mesh sizes. Then the capacity of the jig to clean -20-mesh sizes determines its capacity as a whole. Accordingly, ample capacity is necessary, for it is a furthe principle governing this case that th smaller the size to be effectivel cleaned and, consequently, th greater the number of particles pe ton, the greater the number of clear ing units necessary.

Auxiliary Equipment

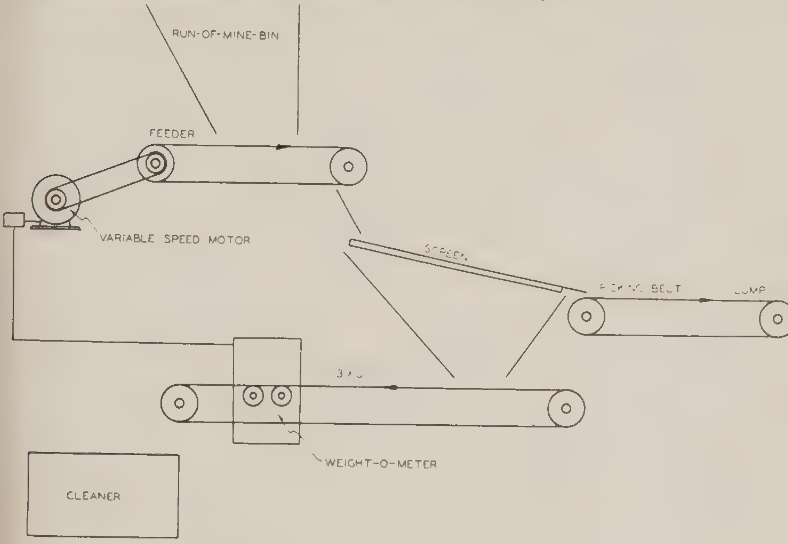
Auxiliary Equipment Ahead of Cleaning Units

The auxiliary equipment to g ahead of the cleaning units shoul supply (1) uniform quantity of coa (2) uniform gradation of size (3) proper moisture content, (4) un form quality.

To supply a uniform quantity c coal, storage sufficient to take car of the maximum delays that ma occur is practically a necessity. A storage breaks up the coal, and cause segregation, the problem involved to minimize these difficulties. I wi take up the problem of preventin segregation later and discuss her only the problem of minimizin breakage.

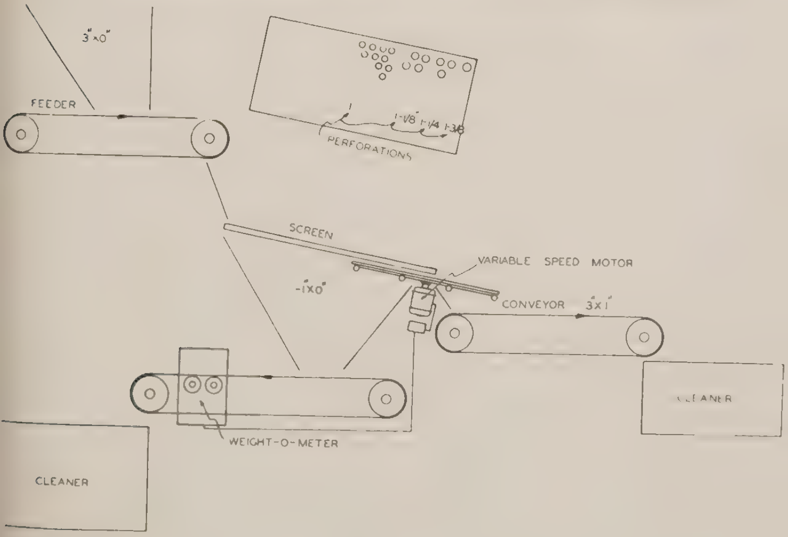
This is especially important whe run-of-mine coal is stored. It ca be minimized by having the bins com paratively shallow with the botto sloping at an agle just a little greate than the angle of repose of the coa Obviously, coal should slide, not dro into the bins from the mine car The same care should be used i designing the facilities for handlin raw lump coal as are now used i loading into railroad cars.

When a sized or semi-sized coa is to be cleaned, the problem c supplying a uniform quantity with minimum of breakage is particularl difficult because the coal break more easily after the sizing and ofte the effectiveness of the cleaning adversely affected by any breakag that occurs. In place of bins, I have two sugestions which can be adapted to various conditions. They a shown in figures 1 and 2.



SIDE VIEW

Fig. 1. Regulation of Tonnage Screened to Give Uniform Supply of Slack Sizes.



SIDE VIEW

Fig. 2. Variation of Limiting Size of Coal Cleaned to Give Uniform Supply of Two Different Sizes

In figure 1 the slack coal is cleaned on one unit and the oversize goes to a picking table. In this case the tonnage of run-of-mine coal delivered from the bin is regulated by a weight-o-meter to give a constant tonnage of slack sizes. The men on the picking table take care of the variations in the proportions of lump.

In figure 2, the slack coal is cleaned on two units and the tonnage is kept constant by varying the limiting size of screen openings. The top view of the screen shows that the openings change at the lower end from 1″ to 1⅛″ to 1¼″. A sliding chute controlled automatically by a weight-o-meter determines the distribution of the coal. Suppose, for example, that the tonnage of 1″x0″ slack decreases. The chute is moved automatically to the right and some 1″x1⅛″ coal is allowed to go into the slack sizes. If, on the other hand, the tonnage of 1″x0″ slack increases, the chute is moved to the left and some of the last coal passing through the screen goes to the 3″x1″ machine. This coal will normally be 1″x⅞″ or 1″x¾″, those sizes being the last to go through the screen. These small changes in the limiting size of feed will, of course, not affect the operation of any of the standard cleaning apparatus to any discernible degree. If more than two cleaning units are used, further divisions of the tonnage can be made by extending this basic idea to additional screens and weight-o-meters.

To supply a uniform gradation of sizes, the second requirement for the auxiliary equipment ahead of the cleaning units, involves preventing segregation in the storage bins and ironing out variations in the sizes of coal coming from the mines.

The answer to the problem of preventing segregation in storage is some form of mechanical distributo to spread the coal over the surfac of the bin. However, the practica difficulties of spreading coal and a the same time lowering it into a bi without breakage are very great Another scheme is the one propose by Marquard. (Marquard, F. F. Th Effect of Coal Segregation, Mixin and Heating Upon the Quality o Metallurgical Coke. American Iro and Steel Institute 18, 1928, 83-112. In brief, this consists of partitionin the top two-thirds of the bin so tha the coarse sizes cannot separate ver far from the fine sizes. If thi arrangement includes a “staircase for lowering the coal in each subdivision and a distributor to delive the coal to each sub-division, it woul be a great improvement over anything I have yet seen.

For mixing coal ahead of th cleaning units to iron out variation in the mine-run two differen methods are advocated. One is large storage pile in which the coa is laid down with a traveling conveyor in one direction and is recovered at right angles. This is necessary in an extreme case where th coal from different sections of th mine varies greatly. The othe scheme, used at Nemacolin Mine, to draw coal from several differen levels in a large storage bin. F any ordinary condition this metho should be satisfactory.

A raw coal of uniform moistu content, the third requirement f the auxiliary equipment ahead of th cleaning units, is particularly i portant to dry processes. In a d separation the coal must be dry f effective cleaning. If coal a refuse are damp enough to stick t gether, it is obvious that no sepa tion is possible; it is imperative th all particles in any separation free to move. To meet this requirement at the average mine, where at least a certain proportion of the time the raw coal contains more or less moisture, either heat-drying of the finer sizes or dedusting with hot air are necessary. The latter of these two methods has the advantage that it adds greatly to the cleanliness of the plant. Also, the greater visibility of the cleaning operation on a dedusted coal facilitates proper adjustment of the cleaning equipment. As a rule the raw coal can be screened at about ½″ and only the fine slack sizes need be dedusted.

A raw coal of uniform quality, the fourth requirement to be provided for ahead of the cleaning units, is especially important for cleaning apparatus that do not have good automatic controls. One answer to this problem is mixing bins. Another has proved helpful at at least one mine where several coals that differ markedly in washing characteristics are being cleaned in the same apparatus. The system used is much like that in large freight yards for the distribution of freight cars. Trips from different sections of the mine are run onto different gravity tracks. From these tracks cars are run onto the dumping track in rotaion in proportion to the tonnage rom the various parts of the mine. This method is reported to be effecive and comparatively inexpensive.

Auxiliary Equipment Following Cleaning Units

In my discussion of the auxiliary quipment to follow the cleaning nits, I am going to take up only e problem of dewatering and dryg. Usually dewatering screens are ed for the coarser sizes and so the oblem really concerns the material sing the finest dewatering screens.

A general principle to be followed in dewatering is to keep some intermediate sizes with the extreme fines. This can be accomplished very readily by allowing at least some of the ½″ to ¾″ sizes to pass through the bottom dewatering screen with the fines and water. This coarse material acts as a filter medium to remove the fines from the water. One very good way of applying this system is found in the so-called "sludge tank." In figures 3 and 4 are two forms of these apparatus. Of the two, the one shown in figure 4, in which the flights convey the coal out of the tank and over the dewatering screen, is a much better dewatering device. As the flights drag the coal over the screen, they squeeze it and thus cause very efficient dewatering. The water passing through the screen is continually returned to the sludge tank in closed-circuit.

The sloping baffles shown are very important in obtaining the maximum efficiency from any settling device. The solids settling from the thin layer of water flowing across the tops of the baffles have only a short distance to drop before they reach the baffles where they are out of circulation. In comparative tests in the Battelle Laboratories, only one-fourth as many solids were found in the overflow with these baffles as without them. In the design of the tank as a whole, care is necessary to secure the minimum of disturbance from the moving flights. If a lower moisture content is necessary than is possible by use of sludge tanks with dewatering screens, centrifugals may be used on the slack sizes dragged from the sludge tank. The effluent may be added to the sludge tank in closed-circuit.

If an essentially dry coal is the objective, the dewatering by centri-

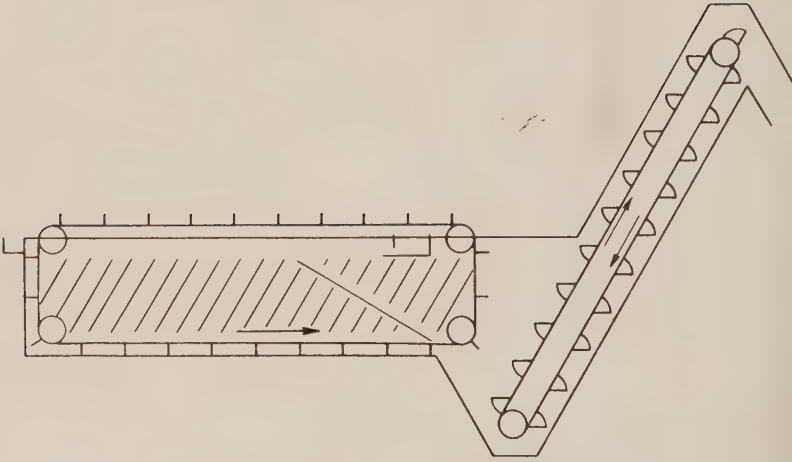
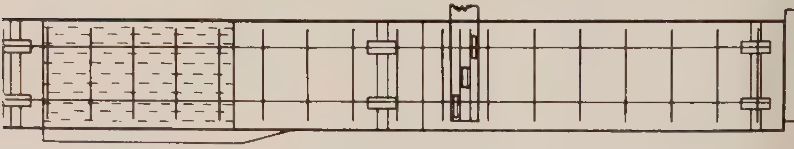
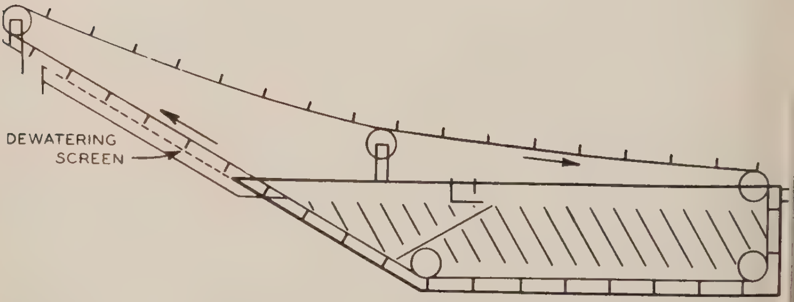


Fig. 3. Settling Tank with Dewatering Elevator.



PLAN VIEW



SIDE VIEW

Fig. 4. Settling Tank with Dewatering Screen

fugals must be supplemented by heat drying. Theoretically, a very wet coal can be heat-dried, but it is inevitable that a large amount of heat will be required to evaporate the water. From the standpoint of the power required, it is probably ec nomical to use centrifugal driers dov to about nine or ten per cent mo ture, for below that moisture co tent the power required per perce of water removed mounts rapid

Accordingly, it is probably economical to remove the balance of the water by heat-drying.

If the dewatering problem is purely one of preventing freezing of the coal in transit, an answer that many coal companies have found satisfactory is to store the slack sizes for a few hours in bins equipped with steam pipes. The heat lowers the viscosity of the water and causes it to drain below the percentage moisture at which freezing ordinarily occurs. Furthermore, even if the temperature is low enough to freeze the coal, usually only the outside of the mass of coal freezes. This frozen portion acts as a non-conductor and slows up the penetration of the freezing toward the center of the car.

A corollary to the dewatering problem is that of water clarification. If there are some dirty products, such as the overflows from refuse elevators around the plant, one excellent way of clarifying the water, if the refuse piles are nearby, is to use them as a filter bed. A portion of the refuse piles is shaped into an impounding basin and the dirty water is pumped into it. The clarified water seeping from the basin is recovered and pumped back to the washing system. Some plants with a bad clay problem have found it necessary constantly to treat a cer-ain portion of the water from the ludge tanks in this manner.

Chairman Thomas: Thank you, Mr. ird, for this talk. It has been ably resented. I would like to ask if ere are any questions anyone cares ask Mr. Bird at this time.

If not, I would like to make one or o announcements. Dinner tickets e on sale, or will be on sale, im-diately after this session in the ll. The dinner will take place at 30 o'clock sharp.

I would also like to call your attention to the fact that Mr. Schonthal still has some football tickets for sale.

Also, the clerk will be on the floor for registration for those who have been unable to pay until now. So if you have not registered and made your payment, I would like to ask you to see the clerk immediately after this session.

I want also to call attention to the fact that at the dinner tonight there will be presented to each person there that booklet entitled "The Story of Coal." It is being presented to the members of the Illinois Mining Institute on behalf of Mr. O. T. Kreusser, Director of the Museum of Science and Industry, in recognition of and in appreciation also of the contribution that has been made by members of the Institute as well as coal operators in furthering the model mine which is on display in the museum at Chicago.

At this time, I would like to ask if Mr. J. B. Morrow is in the room, and if so, I would like to have him say something in connection with the matter of preparation of coal. Mr. Morrow, will you please come forward?

Mr. J. B. Morrow (Pittsburgh Coal Company): Mr. Chairman and gentlemen, it is getting a little late, so I do not think I have very much to add. Mr. Bird seems to have gone over this work very carefully. However, there is one point I would like to make. It seems that in the last few years there has been too much tendency in speaking of coal cleaning plants to talk only of what was done in the actual washing unit. In other words, we want to talk about our coal as having one-tenth or three-tenths sink and so on. In actual experience in the trade, we show that is not what the coal trade judges the coal on, no matter what kind of coal it is.

In other words, with all cleaning plants the most important part of the plant is still in the cleaning and sorting out of sizes and moisture in coal. Some time ago I checked up on complaints received from some 25,000,000 tons of coal shipped, and to my surprise only about 8% of those could be traced to the actual ash or the sulphur, or in other words washing. Fifty-five percent could be traced directly to the screening, mixing and loading. But here we talk about whether this kind of plant will be used or the other kind of plant should be used. I think it should be emphasized more than it has been that the accessory part of the plant may be in many cases more important than the technical operation of the coal cleaning unit, the jig or anything else. I think that is about the only point I want to make at this time.

Chairman Thomas: Thank you, Mr. Morrow. Is there anyone else? Any questions to be asked or statements to be made?

Mr. G. R. Delamater: There is one point I would like to make. In Dr. Leighton's talk this morning he gave us some very interesting information in regard to ways and means of using the extremely fine coal. My personal experience in coal cleaning dates back to around 1900, 1901 and 1902, a good many years spent in coal washing and Government work in connection therewith, and throughout all that experience I found that the fine coal was very largely the source of great expense and great difficulty in cleaning.

In the early days that I spoke of, for instance, here in Illinois, and in the early part around 1905 and 1906 and 1907, you were using jigs almost entirely. This State in those days, I believe, washed more coal than an other State in the United States. think along about 1912 you had som eighty-five or eighty-six plants where as in the latter years you practicall got out of the coal cleaning business

Those conditions were brought o very largely through the high expens of cleaning and the fact you coul not get more money for the coal tha was cleaned—that is, enough more t pay for the cleaning. I do not kno that that condition has changed a lo except the user is demanding a bette coal, and there is more of a penalt proposition than just paying men fo washing coal. But we find as w trace the history of coal cleaning tha in the wet washing your losses o coal were in the fine coal. You trouble was de-watering in the th fine coal, and practically all of you higher expenses. Then when we go into the dry cleaning, it was hope we could handle the extremely fin coal to better advantage. I think i is true that a better job of cleanin can probably be done in fine coal b water washing than by dry.

In a great many instances it ha been found profitable to by-pass th fine coal around your cleaning system and try to find some other wa of using it. I just ran into a cas recently in Canada where they hav been dry cleaning entirely and ar now doing the wet washing and ar are going through a system of w washing in the larger sizes, and believe the coal under five-eights an inch is to be dry cleaned, and the coal through five-eighths of a inch is extremely wet, they are goin to attempt to screen out somewhe around three-quarters of an inch three-eighths of an inch and dry with dryers, the fine coal, and th dry clean it.

In southern Illinois a great deal has been done in regard to de-dusting coal. For awhile it was quite a problem to know what to do with the remainder.

That brings us back to the possibility of briquetting, which has not made a lot of progress in this country. In Germany they have done a great deal. It has been very interesting to me to know that today a process of briquetting is developing in which no binder is necessary, and what seems to me a very surprising statement, that the smoke is only about one-fifth of the smoke for the West Virginia and southern Illinois coal. If these new means of using the extremely fine coal are successful, it seems to me a great deal of the expense and trouble in coal cleaning is going to be removed.

There is also the possibility that in developing these new uses for the fine coal it will not be necessary to clean them—I mean the dust—as extensively as we have been doing in years gone past. I feel that anything that can be done in the study of ways and means of having fine coal and keeping it, for instance, out of wet washers and dry cleaning plants is going to be very helpful in the cleaning business.

One more word I would like to say in regard to some statements this morning, and that is in connection with the work that is being done at he University of Illinois. Mention vas made of requests for funds to arry on that work. That has al-ays been one of our difficulties in eveloping work. The thought has ften come to me that the coal opertors probably should help a great eal in taking a greater interest, pos-bly a greater financial interest than ey have in the carrying on of the perimental work in the various institutions of the country that do have difficulty in getting funds, or even going further and carrying on that work in their own industries very much as is done in the gas industry where experimental laboratories are maintained and carried on year after year for the purpose of testing apparatus used in the burning and use of gas.

Chairman Thomas: Thank you. I wonder if Mr. Hamilton may have something to contribute in connection with this session.

Mr. Charles F. Hamilton: I do not think I have anything to offer on that particular subject, but I would arise in the matter of this rehabilitation of this Bureau of Mines. This special committee is being financed by contributions of members of the American Mining Institute and others. Inasmuch as we have passed a resolution here expressing ourselves, I think possibly the word could be emphasized by a little financial help at this particular moment. And with that in view, I would move you that the Institute contribute one hundred dollars to this committee. Or if the Board of Directors feels it is more beneficial to send fifty dollars to the committee and use the other fifty dollars for the dissemination of information regarding the work of that committee, or some members, that can be done. I so move you.

Chairman Thomas: May I call your attention to the fact—you may not have been aware—but Mr. Weir offered a resolution which was adopted endorsing this movement? Then I asked Mr. Weir if he would include an amendment to the effect that this institution in attempting to endorse the work of the special committee of the American Mining Congress, would likewise make a contribution to the work of this committee, and that amendment or contribution should be left to the Executive Board of the Institute, and both the motion and the amendment were adopted by the Institute today.

Mr. Hamilton: I was out at that time.

Chairman Thomas: Mr. Chairman, I want to say to you in connection with this matter of cleaning that we have had occasion to make quite a study ourselves with reference to cleaning plants, and there is one thing that it seems to me has not been brought out here today, or at least I did not get it.

I know of an institution burning from two and one-half to three million tons of coal per year. One of the real problems in connection with the burning of coal coming from so many places is that relating to the uniformity of the coal that may come from the respective districts. That is to say some of this coal has the ash fushion as low as sixteen hundred, sixteen hundred and fifty to twenty-three hundred and twenty-four hundred. If you reverse the process, you take coal coming from one locality with a lower point of fusion with the ash, and you get into trouble and very serious trouble. I know of this one particular coal, having a low point of fusion with ash, where particularly in the Winter time there may be introduced into the firebox cold air, and a crystallization takes place of that coal, and I say to you it is not only a problem, it is a serious problem and a difficult proposition.

So that the matter of cleaning coal and cleaning up to three or four inches in size, one of the things that occurs to me that an operator supplying a large consumer of coal must deal with and deal effectively with, is the question of furnishing that concern a uniform coal. Not a clean coal one day and a coal not so clea the next day, but coal uniforml clean.

If there is nothing further to com before this afternoon session, I wan to thank you for your attention.

Mr. President, I will turn the meeting over to you at this time.

President Treadwell: I would lik to call your attention to the banque tickets on sale immediately after th close of the meeting. I would lik to have you get your tickets as soo as possible, so that we can arrange t have the proper number of places a the tables.

This morning we gave a good dea of credit to different committees fo their performance during the hearing Personally, I feel that George McFadden, as Chairman of the Progra Committee, and his associates hav performed a wonderful job in thi meeting today. I feel they should b given a rising vote of thanks. If yo agree with me, let's see you stand u

I thank you. Remember, we wi adjourn now until the banquet a 6:30 o'clock sharp.

(Whereupon a recess was taken a this time, the banquet was held a 6:30 o'clock, and at 8:00 o'clock m. the Institute reconvened.)

BANQUET and EVENING SESSIO

8:00 o'clock P. M.

(Following banquet)

Hon. Thurlow G. Essington, Chi Counsel, Illinois Coal Operators Ass ciation (Toastmaster): We will d part from our regular program f just a moment for the purpose presenting to you men two of t honored guests of the evening w have come a long, long way for th meeting. It so happens they mu leave immediately to catch a tra and I know you will want to see the and have them presented to you.

You may judge the particular conditions under which these men do their work, when I tell you they are operating in a vein of coal four hundred and twenty feet thick in places, and which has an average thickness of over one hundred and twenty feet.

I present K. Ogaki and R. Sakakibara, officials of the Fushun Collieries, Manchukuo.

We are very proud and glad to have you with us, and are sorry you cannot stay for the evening. We are happy to have had you here.

President Treadwell: Now, before we go on with the program, there is just a word I would like to say. A year ago we were here, and a great deal of water has gone over the dam in a general business way. Some think we are better off and others do not think we are as well off. It is too deep for me. I cannot tell where we are. But last year we were sighting pretty high in this organization, and I believe to-night we have reached the goal we set last year in membership and accomplishment in the general purposes of this organization. I think that goal was reached from one cause only, and that was co-operation of the membership. I think we have had co-operation in every way. If this organization is to continue and do in the future as it has in the past, let's keep that spirit of co-operation up.

We have this evening as Toastnaster a gentleman who has been ery prominent in the coal industry in his State. For a number of years e has played an important part in he formation and operation of the ational Code. He is well known to e majority of the members of this nstitute, the Honorable Thurlow G. ssington, Chief Counsel of the Illiois Coal Operators Association.

Mr. Essington: Mr. President, honored guests of the evening, and gentlemen, I will, first of all, read this letter dated November 2, 1934, addressed to the Honorable James McSherry, Director of Mines and Minerals, Springfield, Illinois:

"My dear Mr. McSherry:

Please convey to the members of the Illinois Mining Institute my deep regret that I am unable to accept the gracious invitation to attend their annual dinner and conference at Springfield tonight. A speaking engagement at Jacksonville denies me the privilege of being with you.

Inasmuch as Illinois possesses great wealth in its mineral resources, and as mining is one of our foremost industries, the entire program of the Institute is among my paramount interests; for its activities vitally concern all of the people of Illinois. May I take this opportunity to express my deep appreciation to the members for their splendid accomplishments, and to assure them that at all times they have the support and whole-hearted co-operation of the entire State administration.

That the 1934 meeting of the Illinois Mining Institute shall be a very happy occasion, and at the same time be productive of much mutual and general benefit, is my sincere wish.

Faithfully yours,
HENRY HORNER,
Governor."

A number of us were in Washington a short time ago for a two-fold purpose. It was somewhat for the purpose of learning "Where do we go after the NRA?" and primarily for the purpose of seeing George Harrington perform at the annual meeting of the National Coal Association. At the time of that meeting, there was a story going around down there that south of Springfield an operator of a gas station was standing in front of his station one night and a man came down the road with headlights burning brightly and pulled up in front of the gas station. The driver jumped out and turned off the lights of the automobile, stopped the engine, and started out in a dead run, and as he got to the corner he stepped on a stone and fell flat. The owner of the station stepped up to him and said, "Mr. Sandoe, I am sorry about that. I hope you did not hurt yourself any." He said, "It is all right, I do not think I could have made it anyhow."

Now, if C. J. Sandoe ever arrived anywhere on time, he arrived in this position of newly elected President at an important time in the affairs of the organization. I think we might at this time hear what Mr. Sandoe has to say for himself.

President-elect C. J. Sandoe: Now, listen, fellows, this is a rough passage, and I do not want you to stub your toe when you go after members. This organization is your organization and is a post at the crossroads of the coal industry. There are many things that can be accomplished that have not been, and that is up to you. I am willing to do everything and give my time, but we must have cooperation. I would like to have as many of you on the boat trip next Summer as possible, and when next Fall comes let's try to keep up the good record of the membership. Of course, we only want the best, for I do not want to spoil you. You can rest assured I will do all I can for you.

Mr. Essington: I understand it is the custom of this organization at this time on your program to present very briefly the newly elected Officers and members of the Executive Board.

(Whereupon the newly elected Officers of the Institute were presented.)

I want to present also some of th guests of the Institute. Mr. Jame White, President of the Indiana Coa Mining Institute. Byron Bird, Chie Concentration Engineer of the Battelle Memorial Institute, Columbu Ohio. George B. Harrington, Pres dent of the C. W. & F. Coal Compan of Chicago and an associate of th speaker of the evening. Mr. J. I Morrow, Preparatory Engineer of th Pittsburgh Coal Company. Mr. L. VanPelt, of the Museum of Scienc and Industry, who wants to spea to you just a moment in regard to certain clause in "The Story of Coal.

Mr. J. L. Van Pelt: I do not war to speak to you, but I have the dut of calling attention to this booklet o the table. You remember two year ago the Director addressed you an told you about the coal mine in pro pect. It has been built, and in reco nition of your services in that co nection he hands you herewith th booklet which tells you about th exhibit. It contains therein one two errors, mostly of details, whic will be obvious to you coal men, b which were the result of unusu haste in preparation. If you will so kind as to overlook those, such the spelling of a name and one two errors of that kind, I wish to c your attention to the fact it is effort to do something which is n done otherwise in many parts of th country, to tell the people not f miliar with the industry what t history is. That is its chief purpo

Mr. Essington: The officers of t Illinois Mining Institute have eve reason to feel very proud of the me ing which they have had this we and of the attention shown by y men. I take it that it is not an ac dent that there has been an unusually large attendance this year. The position of the industry perhaps might be somewhat represented by a story of the colored preacher, who having opened his services in the usual way, proceeded to read the Scripture and just as he got fairly well started on the Scripture a near-ripe tomato sailed through the air and struck him in the face and spread over his face pretty well and down his vest. He went right ahead reading the Scripture, took his handkerchief out of his pocket and mopped himself the best he could, but did not hesitate in the reading. He finished the reading of the Scripture, and then said, "Now, the congregation will sing a song. After that we will take up the collection. After that I will preach the sermon, and then we will sing another song. Then the ushers will close the windows and the doors, and we will have a hell of a fight here in this church."

It has been almost my observation during the last few years that the coal business is pretty much a hell of a fight from start to finish, all the time. But in addition to the ordinary conditions, the usual conditions that reflect the industry, there are a number of unusual situations which, as I say, are the reasons probably for your very great interest in this meeting this year.

There is the unusual and unprecedented and extraordinary competition of oil and gas, and this new menace, water power and Government financed power, and the compeition within the industry which is lways with us, and there is the cometition from without which is known s the triple menace. In addition to hat, your salesmen are approaching his new sales contract season without ny assurance of what your wage conditions of operating are to be, and without any very distinct knowledge as to what Government regulations will be placed on the industry. There is the wage contract expiring March 31, there is the expiration of the Code and the NRA early in June, there is an approaching session of the Legislature, and approaching session of Congress at which all of the bills that may harass your industry will be presented, unemployment insurance, workmen's compensation, limitation of hours, old-age pensions, and all those things. There is absolutely certain to be a bill presented by one Congressman in particular and possibly others, possibly by the Administration, for the stabilization of the coal industry. There is a great deal of discussion in Washington as to the almost parallel problem of those natural resource industries of coal, oil and lumber.

Of course, there is all the time this question of the NRA which has been injected into the situation and, as Mr. Treadwell says, in regard to which there is a great deal of difference of opinion. When the first NRA came out there were various interpretations put upon those letters, and then followed the AAA and the HOLC and the other alphabet. I heard last night for the first time of the alphabet as applied to the calendar, and it ran somewhat like this: In 1932 there was the FDR; in 1933, the NRA; in 1934, the IOU; in 1935 there will be the SOS, and in 1936 the GOP. Now, not meaning to inject any politics into the situation, because of course the question is larger than any political consideration, yet for the same reason that as civilization becomes more complex, as the dealings and relations between individuals are complicated, as civilization becomes more complex we have the boll weevil, and the corn borer, and the foot and mouth disease, and the athlete's foot and all those things we did not used to have, but we have them and they will be with us forever; in the same way, during the years have grown up the Anti-Trust Act, the Interstate Commerce Commission, the Federal Trade Commission, the Federal Securities Act, the NRA and those various other Acts in the evolution of business relationships.

I do not know what our speaker is going to say, but I know it is my observation as I have studied it here at home and seen it in operation in Washington, that we are going to have the NRA in some form, or the principles of it next June. The probability is no one in this room will ever see the time when all of the principles of the NRA, many of which are not only unobjectionable, but cannot be assailed—I say there will not be any of you who will live to see the day when some of the provisions of the NRA will not be applicable to this industry and to business in general.

Now, we are particularly fortunate this evening, at this time when we all want to and must soberly reflect upon these changed conditions in these changing times, to have with us a speaker, a man who is known throughout the country as one of the Four Horsemen. He was one of those four in the east representing the north and south who in the troublesome times of a little more than a year ago represented the coal industry in the entire east in its negotiations with labor in the first place and its negotiations with reference to preparation of a Code to conform to the NRA. He is a member of the Code Authority for Division No. 1, which is this great territory to th east and south of us. He is a directo of Appalachian Coals, Inc. He is th Vice-President of the Stonega Cok & Coal Company, Inc., operating a Big Stone Gap, Virginia, and Vice President of the West Moreland Coa Company, operating in Pittsburg Pennsylvania. He is associated wit Mr. Harrington of our own state i the operation of a coal mine i West Virginia. He is a man of wid experience, a fighter, a successf operator experienced in every phas of the operation of coal mines, n only experienced but outstanding successful in those operations.

I am very much pleased to prese and introduce to you Mr. Ralph Taggart, of Philadelphia.

Mr. Ralph E. Taggart: Mr. Toas master, Mr. President, gentlemen the Illinois Mining Institute, you a about to be subjected to an orde for which no doubt you are fully pr pared. I wish there was somethi in my past career or something my future probabilities that mig permit me to accept the kind intr duction that has been given to me the Senator without some word protest. But it brings to my mind story which they say occurred in t south, where we had a very trifli colored brother who neglected h mother, abused his wife, and fail to provide for his children. The po colored brother passed to the Gre Beyond at a time when the neg pastor of his flock happened to absent from the city. It was nece sary for them to bring in a new a uninformed pastor to pronounce t funeral service over the depart brother. As he waxed eloquent ov the devoted son, the kind and aff tionate father and the devoted h band, the bereaved widow stood it just as long as she could, and then turned to little Miranda at her side and said: "Mirandy, you jes tip-toe up to de coffin and peek in and see is dat your Paw."

As a matter of fact, there is a little doubt in my mind as to just why I should be here. In the good old days of prohibition they tell the story of a man who went to a party at Roanoke, Virginia, and in returning from the party it was necessary for him to cross a bridge. As he went across the bridge, he looked down at the river. He stopped, and he looked, and he looked, and he looked. An officer noticed this predicament and stepped up, tapped him on the shoulder, and said: "My man, you have been here a long time. Now, you must go home." The man said: "Certainly, Mr. Officer, I will go home, but before I go home will you answer me just one question?" The officer said: "Certainly, I will answer a dozen questions if you will just go home." The man said: "What is that I see down there?" The officer replied: "That is the moon." Then he said: "Now, I have answered your question, and you must go home." The man said: "Certainly, Mr. Officer, I will go home, but before I go home will you answer me just one more question?" "Certainly. A dozen questions, if you will go home." The man then said: "Well, Mr. Officer, if that is the moon down here, what in the hell am I doing up here?"

With all the capable and competent entlemen that you might have had o address you here this evening, I aturally wonder what the hell am I oing up here.

When I was asked to make some marks here this evening and no bject was assigned, I was somewhat familiar with the Illinois Mining Institute but not entirely so. I had heard a great deal of your activities. At the same time, I was not exactly informed as to the consist of your membership. Upon making inquiry, it developed that the active membership of the Illinois Mining Institute is largely composed of gentlemen who are engaged in the mining and preparation of coal—in fact, its production—rather than those engaged in its sale and distribution. It therefore occurred to me that if I might bring any message to you at all it might be along the line of those things that the operating men have to devote the majority of their attention to, and that is the question of producing the commodities which they have to sell.

Now, to discuss the cost of production is entirely too great a subject to endeavor to go into at such a time and place. It is a boring subject at best, and I thought from that standpoint I had best confine myself to the principle and major item of cost, and that is usually on the labor cost of coal.

As an operator operating in that section of the United States that is accredited with seventy per cent of the production of solid fuel of this country, naturally those things that have gone on and those things that will go on with reference to wage negotiations, and so forth, must have their bearing, and must have their effect upon the adjoining, adjacent and competing territories.

It is not my purpose to go into the history of the wage negotiations in the east beyond the period of the formation of the Code. It is necessary, though, to place a certain background to any discussion of this nature, and it must be borne in mind that following the crash of November, 1929, we entered upon a series of unprecedented depressions insofar as our memories go, which culminated in the national banking holiday in March, 1933. It was under these conditions that the National Industrial Recovery Act was promulgated and was passed.

We found at that time a desperate people, willing to submit to disciplinary plans and disciplinary procedure in order that any order might be brought about. It was under those conditions that we found, and under that Act that we found it was necessary, under the law, to promulgate a so-called Code of Fair Competition. We were informed and we had reason to believe that if the eastern section of the United States were to bring in as the major producer a Code of Fair Competition that could be agreed upon by that industry, it would have its bearings on other Codes of competition that might be provided for the industry as a whole. This was in the early days of preparation, and we were sufficiently sanguine to believe that the Code we might promulgate and prepare, if properly conceived and not in conflict with law, would be given a certain amount of consideration.

Proceeding upon that viewpoint, we did prepare a Code of Fair Competition. We found as we proceeded that a Code of Fair Competition was going to be provided for the entirety of the industry, and that our Code of Fair Competition was going to be lost some place. We had assumed this Code we were promulgating and preparing was going to be more or less a guide for our division and other divisions to be in a position to submit their codes. We found some thirty of them. We were rather disabused in our minds in thinking we were going to have too much to do in the promulgation of this Cod of Fair Competition.

It reminds me to a certain exter of the conditions which I understan existed in a bridge game, where th dealer said he would pass and th gentleman to his left likewise sai he would pass. Victor Emmanue said "I pass." Mussolini said "Lik hell you do, you bid four Spades an I double you."

We found that although we wer promulgating this Code that if w put certain things in it we considere to be desirable it would not b approved.

We finally did come out with Code. We found it was a Code tha was to a certain extent sponsored b the gentlemen of Illinois, and in on of our conferences one evening o the NIRA we desired to find out jus what the signatures on that Cod might be. So we made inquiry as t what had become of the general Cod which was submitted by so man and we found to our amazement whe we had made this inquiry that you Code had been placed in the Cod file. That seemed to be a rathe peculiar place to put a Code, but w found it was in the Code file an nobody knew where the Code fil was, and consequently we think ou original Code was placed perhaps i the Code file and got the same co sideration perhaps that your Cod got, and they perhaps still rest i that particular Code file.

From the standpoint of the easter section of the United States, it mus be borne in mind that following th crash of 1929 no very good basis o wage existed in the eastern part o the United States. As a matter o fact, we had no basis of wage. Du ing that period, I may say for th benefit of the eastern operators—ar it is what I believe to be an eve lasting credit—whether or not that operator's decisions were right or wrong, whether he conducted his business well or poorly, he did operate and endeavor to operate for the benefit of the employes with little thought of gaining any profit.

It was in that atmosphere, at a time following a four year depression that we found after the Code had been promulgated we, too, must enter into some sort of collective bargaining. We had observed Section 7-A of the Industrial Recovery Act, but perhaps we had passed it a little too lightly. We thought collective bargaining meant collective bargaining among our own employes. At the formation of the Code, during the early phases, conferences were held with certain gentlemen of Illinois, and we endeavored to determine whether or not we should go as one group or as two groups. It was rather readily determined that the conditions that confronted the State of Illinois were different from the conditions that confronted the coal industry of the east, and perhaps under the existing conditions, for the time being, it would be best if we went our way and best if you went your way, because of the fact that the negotiations and the matter of negotiating which have been satisfactory to the Illinois operators in the past and desirable to them, that of collective bargaining with a national organization, although satisfactory to ou would be entirely undesirable rom the standpoint of the east.

As a matter of fact, during the arly phases of the situation, there ere those of us who felt, both north nd south, that negotiations with the nited Mine Workers of America re entirely undesirable and a prosition to which we were never ing to submit. We, I believe, felt at that time, a great many of them and particularly the operators of the north, that they might secede from the Union before they would do any collective bargaining with anyone other than their own employees. We, of the south, who had already tried secession and found it did not get along so well, we were not going quite that far.

During the negotiations, however, of the Code and at the same time negotiations on wages, we rather reluctantly found we had a more or less misconception of just what the new Code of business was going to be, and that while we were busily engaged endeavoring to promulgate a Code the United Mine Workers of America were taking particular advantage of the law which has been enacted—and I do not mean by that they were taking any measure or any degree of unfair advantage, but were doing those things which perhaps they should have done and which they perhaps had a perfect right to do—while we were in the position we would not negotiate with them in any form because they were not the representatives of our employes, we of the south found they were a complete representative of our employes and we were completely organized, and were ready and willing to do the type and character of negotiating you gentlemen had shown us the way to before.

We were confronted, therefore, with a very difficult proposition, and that is that we had no basis for wage negotiations as between the north and the south. Consequently, organizations that could speak for the industries at large had to be very hurriedly thrown together. They were thrown together in the north part of thte Appalachian region, comprising those states of Pennsylvania, Ohio, Maryland, and northern West Virginia. In the south, a similar organization was set up known as the Appalachian Association, which consisted of the southern part of West Virginia and Ohio, and Kentucky, insofar as the eastern boundary was concerned, part of the state of Tennessee and the state of Virginia. We were then in a position to do some form of bargaining with each other and with the representatives chosen by our employes.

We found an exceedingly great amount of difficulty in bringing about a proper wage differential as between the northern part of our section and the southern part of our section. Finally, through negotiations and through agreements, it was determined that the proper differential of the wage basis, on a daily basis of hourly earnings, would be forty cents in the north above the south, with an intermediate wage scale for northern West Virginia.

So far, so good. We had cooperation and assistance on the part of the NRA and on the part of the United Mine Workers of America, endeavoring to permit us to a degree to establish those differentials at the time, not to be binding on any party or to be a precedent for future wage negotiations. Under that setup, through compromise, with the north continuously contending there should be no differential as with the south, and the south contending that the wage differential should be in excess of forty cents per day, we entered into the collective bargaining feature as provided for in the Code and under the National Industrial Recovery Act.

A dispute already existed as to the amount of wage differential for the hourly workers, with no solution as to what the contract or the piece workers on the hourly rate should b It was finally determined that th Code should increase the loading rat by ten cents per ton. There was relationship of wage as between Ohi Pennsylvania, northern West Vi ginia and central Pennsylvania whic made that rather easy a solution, b cause having previously had wag scales which were related it was n difficult for them to bring them bac again into the relationship that ha previously existed.

In the south, during this period c depression that I have referred t the operator in the conduct of h business had made sales of coal an followed with the reduction c wages, or in anticipation of sales c coal had reduced his wage to suc an extent that insofar as the contra or piece workers were concerne there was no uniformity of relatio ship of wage as between mines in th same district or as between compe ing districts.

It has been also necessary to pr mulgate and to form a wage scal Our northern friends continued suggest and to insist that we we holding out on them to a certain d gree because we would not give the the tonnage rate. As a matter fact, it had been the practice of o field to a very large extent to loa by the car, and as a further absolu fact we did not know as districts a only knew as individuals what were paying as a wage for contrac and dead work.

Thirteen districts were represent in the conference for the south. was finally agreed that the avera rate for the south for each of t twelve to thirteen competing distri should be calculated, and to th should be added the relationship w the north, which in this particular stance amounted to nine cents a two mills per ton, which happened to be the difference between the four dollar sixty cent basic day rate for the north and the four dollar and twenty cent basic day rate for the south. On that basis there has been some question and still is in the minds of many of the companies as to whether all the districts wanted the absolutely proper and adequate wage rate insofar as their tonnage is concerned, but the only thing that could be done was to add the nine cents and two mills to what the particular district said was their average loading rate, to which was added also a percentage to what they had been paying for yardage and dead work.

Under that condition, we naturally came out with twelve to thirteen loading rates which were not related each one to the other. It was perhaps as good a job as could be done at that time, and the wage basis for the south was put up and the wage basis for the north was put up, unsatisfactory to the south, unsatisfactory to the north. It was unsatisfactory to the north because of the difference of wage, unsatisfactory particularly to the south because of the difference in coals and the cost of coals that were highly competitive. That difference amounted to as much as fourteen cents to fifteen cents.

Ample time existed between the time of the signing of the Appalachian agreement and the renewal of the agreement in April of this year o have ironed out those differences nd brought about a proper wage reationship as between competing osts. There was but little disposiion on the part of those who had e advantage in the wage rates to oncede anything to those that were aying the higher rates. There was tle disposition on the part of those at had been securing the higher rate to accept a lower wage rate.

Consequently, in the formation of our wage scales in April of this year, through the stress of consequences and the haste of doing business, it was necessary again to add a flat amount to the tonnage rate, which permits the differentials that now exist to continue to exist, and they exist up to the present time, unsatisfactory to labor, unsatisfactory to the operators.

In order that these conditions might be corrected to a certain degree, it was determined and made a part of our last agreement that there should be a commission composed of equal representatives from the south, equal representatives from the north, and an equal number of representatives of the United Mine Workers that should make a study of the differential relationship north and south in the Appalachian territory and make a recommendation to a conference to be had in December of this year.

The progress which might be reported on that is similar to the progress so often reported in so many negotiations of this kind. Up to the present time the progress, however, on the part of the commission empowered to do this job is that very little if anything has been done along that line. If I were to be asked what is the prospect of there being anything substantial done between now and our next wage conference, I would have to confess to you gentlemen that we are doing but little as between the north and south to iron out and to satisfy those interested in the differentials study. The condition in the south, with thirteen different tonnage rates, naturally is a condition which is very unsatisfactory. Perhaps nothing better could be done in the last conference, but something perhaps should be done by the next conference, and for that purpose a committee, an inter-south wage commission, was appointed.

The progress of that commission is similar to the progress of the commission that is working on the subject from the standpoint of the north and south. It appears nothing can be done or nothing will be done between now and the next wage conference.

I bring this matter to your attention because I think you will agree with me that the question of the wage relationship east is going to have its bearing on your problem here. I want to let you understand that you are going to secure but little if any benefit from the deliberations that may be going on in the east, because it is apparent to those of us there that nothing is going to be done, and we will be in a perfectly chaotic condition when we come to the time of the next wage negotiations.

It is unfortunate that I cannot bring you a message that would be more encouraging than the message I am giving you here. And I am sorry and embarrassed from the standpoint of our industry in the east, and I lay the blame largely at the hands of the operators and not in the hands of the United Mine Workers of America that no progress is being made along this line.

I recognize that we are going to be in a great deal of haste, and will naturally be in a great deal of hurry when it comes to negotiating for our next wage agreement, without any prior work or any prior accomplishment—or practically no prior work or accomplishment—being made by the commissions that were appointed on this subject. Whether or not we can complete our work by April 1 contains some element of doubt. hope that may not be true. I hop we have an opportunity to negotiat these matters so that we can do thi thing deliberately and do it cool and so that we need not be in to great haste.

I am reminded of a little boy tha was on his way to school in the mor ing, and as he walked down to scho he kept repeating to himself: "O God, don't make me late. Oh, Go don't make me late." All of a sudde he stubbed his toe and stumbled an fell down, and said: "Well, Jes Christ, there's no need to push me."

I am fearful we are going to pushed to such an extent in our ne negotiations that we may stub o toes and fall down.

I do not know if there is anythi more that I could say to you peop except to make the report to you to the progress that is being ma along that line. It strikes me, thoug that I would be more or less dereli in duty if I did not go away fro the principal thing that I wanted talk about and make a report as what is going on in our wage negoti tions, if I did not briefly call to yo attention some of the things that a being done that look as though th might have a most detrimental e fect upon our industry.

We cannot at any time lose sig of the competitive condition we a in, not only as among ourselves b as between competing industries a competing fuels. It is to be recall that at the time of our negotiatio for our first agreement we were t that there would be some form legislation introduced that mig place an excise tax on gas. That fo of legislation has not yet come pass.

As Senator Essington has point out, we are facing the next session

Congress. It is unreasonable to me that such a great industry as the coal industry would be further handicapped by lack of control of those industries that are in direct competition with ourselves. It must be borne in mind that the railroads of this country—and perhaps they need it—are asking for certain freight rate advances that are going to place our production at a still further disadvantage with our competitors if those freight rates are allowed to become effective. I am not capable of saying whether or not the railroads are entitled to and should have an advance in rates. But I do know that if this advance—if it makes a further cost to our consumer of as much as thirty cents per ton, it is going to place our production at a very serious disadvantage with competing forms of heat and energy.

We must recall that in a period practically thirty years ago, when the solid fuel of this nation contributed about ninety percent of the Btu value that was consumed in this country, its greatest competitor at that time was oil, which contributed about four and one-half percent of the Btu consumed in this country, that natural gas came next with a contribution of about 3.3% while hydro-electric power had only slightly less than two percent converted into Btu value. The last figures that I have seen indicate that solid fuel in this country has fallen from ninety percent to fifty-six perent, that in a period of thirty years il has increased from four and onealf percent to twenty-six percent, hat natural gas has increased from 3% to approximately eight and onealf percent, and hydro-electric ower from less than two percent to ght and one-half percent.

To say those things differently, it eans that coal has lost forty-six percent while petroleum has increased five hundred percent, while natural gas has increased one hundred and seventy percent, and the hydro-electric power has increased three hundred and seventy percent.

It is perfectly apparent from those figures that coal is not playing the important part in the Nation's industrial life that it heretofore played, and that competition can be brought about, if unregulated, and unrestrained, while the coal industry is to a measure regulated and restrained, that will do further damage to the coal industry and put thousands of our miners out of work and reduce our output by thousands of tons.

Our competition, gentlemen, was sufficiently severe prior to the time that the Federal Government determined it was its place to form some kind of competition with our industry and with the utilities. It is an astounding fact that there is now under development and has been appropriated or will be appropriated the sum of $940,000,000 for the purpose of this Government getting in competition with its people, which will have the effect of placing many miners and many coal mines out of commission. The hydro-electric power—and I refer particularly to the Tennessee Valley as one of the outstanding instances that has occurred recently—is going to be of material detriment to the coal operators and coal miners of the east. Many other projects of this nature are in the course of development or have been projected, which will not only affect the operators of the east but will affect the coal operators and their employes throughout the entirety of this Nation.

Those plants that are now under development and being built have a capacity, if operated to capacity, to replace forty million tons of coal which will in turn place an additional forty thousand miners out of employment.

I am sorry that the coal industry is not organized as I think it should be, and has not taken full advantage of the opportunities which have been theirs to organize and voice their opposition to measures of this kind. Some things have been done. Good work to a certain extent has been done, but not all of those things that should be done have been done by the coal industry and its members. And I think it is the bounden duty of every man in the coal industry to inform himself of the things that the National Government is doing, to recognize the fact that the power to tax is a power to destroy, and that it is perhaps not the purpose but it has the same results that the people of this country are being taxed in order that the Government might go in competition with them, and will have the effect of putting them out of business.

It is my thought that since it is too late to do anything and get any commitment from the different Congressmen prior to their election, that it is the bounden duty of every man engaged in this industry for his own benefit, for the benefit of his family, for the benefit of his employes and for the benefit of the community which looks to him for sustenance, it is his duty to see his Congressman, to see his Senator, and prior to so doing to inform himself to the best of his ability to plead with him that there be no further legislation or no further appropriations, that there be no question in the next Congress of a shortening of the work day or things of that kind by legislation, but that those things be permitted through negotiation, and that ther be nothing further done along th line and if possible stop these thing now going on of the Governmer going into competition with its ow citizens in the production of hydr electric power, which is going to hav a most detrimental effect.

Then we should insist that ther be some regulation—we had assu ances there was to be some regulatio —with reference to oil. We had bee told that oil would no longer be a increasingly detrimental propositio I wish that might be true. But observed recently the price of gas line, which was recently seventee cents in New Jersey, is being retaile at eight cents with the tax. In Pen sylvania, due to this trade war, gas line that had been retailing for eig teen cents is now being retailed thirteen cents, and good grad of fuel oil are now being sold five and one-half cents which brin the oil competition back in the san relationship it was prior to its reg lation being assumed by the Depar ment of the Interior.

It is our bounden duty to plea with our Congressmen and citize that they insist on the excise tax natural gas, that it may make further inroads on our industry. is our further duty to see that th development of hydro-electric pow is abandoned, which means nothing the communities that these pow plants are built to serve because every instance so far as I am infor ed, and I have endeavored to lo over the very good articles that ha been put out on the subjects, there no need for the additional electri energy in the communities whe these power plants are being co structed, because the power pla already in existence have ample ca city and reserve capacity to take ca of the needs of those communities for some time and some years to come.

The Government, by States, has ample power to regulate and to control, and it is no function of Government nor was it the intention under the Constitution of this Nation that the Government should get into competition with its citizens. I hope that everyone here is and I hope that the industry throughout the State will organize itself to a better degree to cope with this situation, and since we have thus far failed to get our message to the people, that all of your members in the influential positions which you hold will make it your business to see your Congressmen and see your Senators prior to the time they go to the next session, and get a commitment if possible.

I was informed since I have been here today that on the Tennessee Valley Project—there are twenty-nine Congressmen, I believe, from the State of Illinois, and that when it came to the question of voting for the appropriation for the Tennessee Valley Authority twenty of them voted, twenty of them from this great coal producing State, in Congress voted for the Tennessee Valley appropriation, that six voted aaginst it, and three did not register as voting. Certainly the influence which you gentlemen have should be able to make a greater impression on the Congressmen who represent you that as a State so vitally interested in the production of coal something should be done in order to change their sentiment in Congress.

Mr. Toastmaster, Mr. President, and gentlemen, if I have brought to you any message whatsoever, I am indeed most happy. I want to take this opportunity to say that I shall be forever grateful for the many courtesies and hospitality that have been shown me on this occasion.

Mr. Essington: I am sure, Mr. Taggart, that that applause is evidence of the very great appreciation of the gentlemen of this powerful exposition of some of the problems with which they are confronted in the east, and which are very similar to and not very dis-similar from the problems confronting the operators in this State.

Now, we are just immensely pleased that Mr. Taggart kept his engagement and came here this evening and told us of the difficulties with which they are contending in the east. I thank you very much, and we appreciate it very much, Mr. Taggart.

On this subject of water power, TVA and the Government injecting itself into private business, the Institute secured some copies of a bulletin issued on that subject which will be passed out at this time, or if that is inconvenient you can each get a copy as you go out.

At this time, I turn the meeting back to the newly elected President of the Illinois Mining Institute.

President Sandoe: I would like for all of you to take heed to what has been told you relative to your Congressmen and Senators, as I think that is one of the most important things you have to do now. We must get some support. There has been some very wonderful work done in trying to hold off the competitive fuels.

I know of no further business, so we will stand adjourned.

(Whereupon the Institute meeting was declared to stand adjourned **sine die.**)

CONSTITUTION AND BY-LAWS

Adopted June 24, 1913
Amended Nov. 12, 1926
Amended Nov. 8, 1929

ARTICLE I.

NAME AND PURPOSE

The Illinois Mining Institute has for its objects the advancement of the mining industry, by encouraging and promoting the study and investigation of mining problems, by encouraging education in practical and scientific mining, and by diffusing information in regard to mining that would be of benefit to its members.

ARTICLE II.

MEMBERSHIP

Section 1. Any person directly engaged or interested in any branch of mining, mining supplies, mining appliances, or mining machinery may become an active member of the Institute. Any person desiring to become a member of the Institute shall fill out a blank for that purpose, giving his name, residence, age, and occupation. This application shall be accompanied by one year's dues of $3.00. Each application for membership shall be submitted to the Executive Board, who shall make an investigation as to the qualifications of the applicant, and shall be authorized to elect to membership and issue a certificate of membership to such applicant subject to the ratification of the next regular meeting of the Institute.

Section 2. Any person of distinction in mining may be elected an honorary member of the Institute by two-thirds vote of the members present at any regular meeting. Any member who has been an active member of the Institute and shall have retired from active business in mining may become an honorary member.

Section 3. The annual dues for active members shall be $3.00 and any person in arrears on August 1, of the current year, after having been sent two notifications of dues, to b dropped from membership. Membe in arrears for dues will not receiv the printed proceedings of the Inst tute.

Section 4. Any active memb may become a life member by th payment of $50.00. Funds receive from life members are to be investe and only the income from these fun may be used in the regular operatio of the institute.

ARTICLE III.

OFFICERS

Section 1. The officers shall co sist of a President, Vice-Presiden Secretary-Treasurer and twelve Ex cutive Board members. The servic of all officers shall be without co pensation.

Section 2. Nominations for of cers and the executive board shall b made by nominating committee three (3) appointed by the Preside at least thirty days before the annu November meeting, provided th anyone can be nominated on th floor of the meeting for any offi for which an election is being hel

Section 3. The officers and exec tive board members shall be elect by ballot, annually, at the regul November meeting and shall hold o fice for the ensuing year.

Section 4. In case of death, r signation, or expulsion of any o ficer, the executive board may fill t vacancy by appointment until t next regular meeting, when the v cancy shall be filled by regular ele tion. In case of a vacancy in t office of president, the duties sh devolve upon the vice-president.

Section 5. The executive boa shall consist of the officers a twelve other board members.

ARTICLE IV.
DUTIES OF OFFICERS

Section 1. The president shall perform the duties comomnly performed by the presiding officer and chairman. He shall sign all orders for payment of money by the treasurer, and with the executive board shall exercise a general supervision over the affairs of the Institute between sessions.

Section 2. The vice-president shall preside in the absence of the president and perform all the duties of the president in his absence.

Section 3. The secretary-treasurer shall keep a record of each meeting, shall read and file all resolutions and papers that come before the Institute, countersign all orders for money which have been signed by the president, and shall purchase necessary supplies under the direction of the executive board.

He shall keep a true record of all money received by him and payments made on account of the Institute. He shall pay out no money except on an order signed by the president, and countersigned by himself, and shall retain these orders as vouchers. He shall give bond in such sum as the Institute may provide, the premium on said bond being paid by the Institute.

He shall act as editor-in-chief for the Institute and may furnish the newspapers and other periodicals such accounts of our transactions and discussions as are proper to be published. His own judgment is to prevail in such matters unless objection is lodged at a regular meeting or by the executive board.

The retiring president shall act ex-officio in any capacity for the ensuing year.

Section 4. The president shall appoint an auditing committee annually to audit the accounts of the secretary-treasurer, and said audit shall be submitted to the November meeting of the Institute.

Section 5. The executive board shall perform the duties specifically prescribed by this Constitution, act as program committee for each meeting, determine what is to be published in the proceedings and shall perform such other duties as may be referred to them by a regular or special meeting of the Institute.

ARTICLE V.
MEETINGS

Section 1. Regular meetings shall be held in June and November of each year and on such days and in such places as may be determined by the executive board of the Institute. Notice of all meetings shall be given at least thirty days in advance of such meetings.

Section 2. Meetings of the executive board shall be held on the call of the president, or at the request of three members of the executive board, the president shall call a meeting of the board.

ARTICLE VI.
AMENDMENTS

Section 1. This Constitution may be altered or amended at any regularly called meeting by a majority vote of the members present, provided notice in writing has been given at a previous semi-annual meeting of said proposed change of amendment.

ARTICLE VII.
ORDER OF BUSINESS

At all meetings, the following shall be the order of business:

(1) Reading of minutes
(2) Report of executive board
(3) Report of officers
(4) Report of committees
(5) Election of new members
(6) Unfinished business
(7) New business
(8) Election of officers
(9) Program
(10) Adjournment.

ILLINOIS MINING INSTITUTE

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CLARKSON, JOHN L., Pres. Clarkson Mfg. Co., Nashville, Ill.
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CONWAY, C. C., Chief Elec. Consolidated Coal Co., Herrin, Ill.
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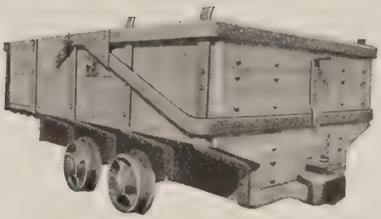

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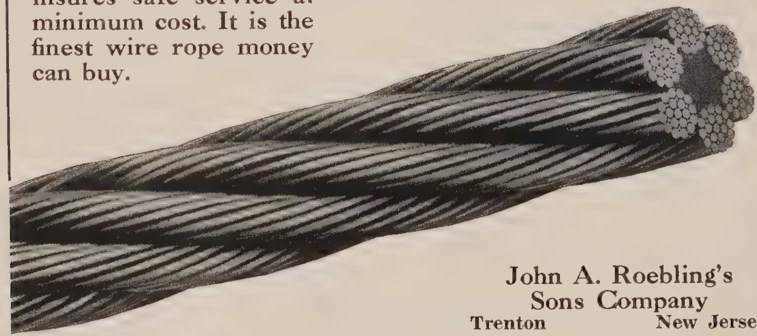

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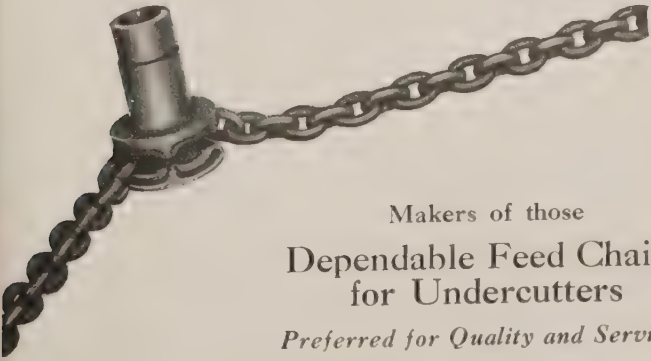

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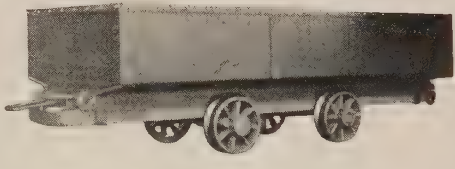

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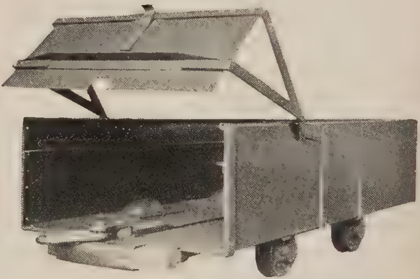

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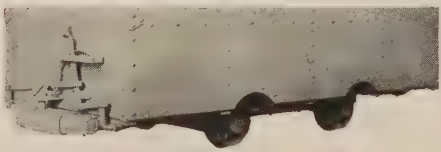

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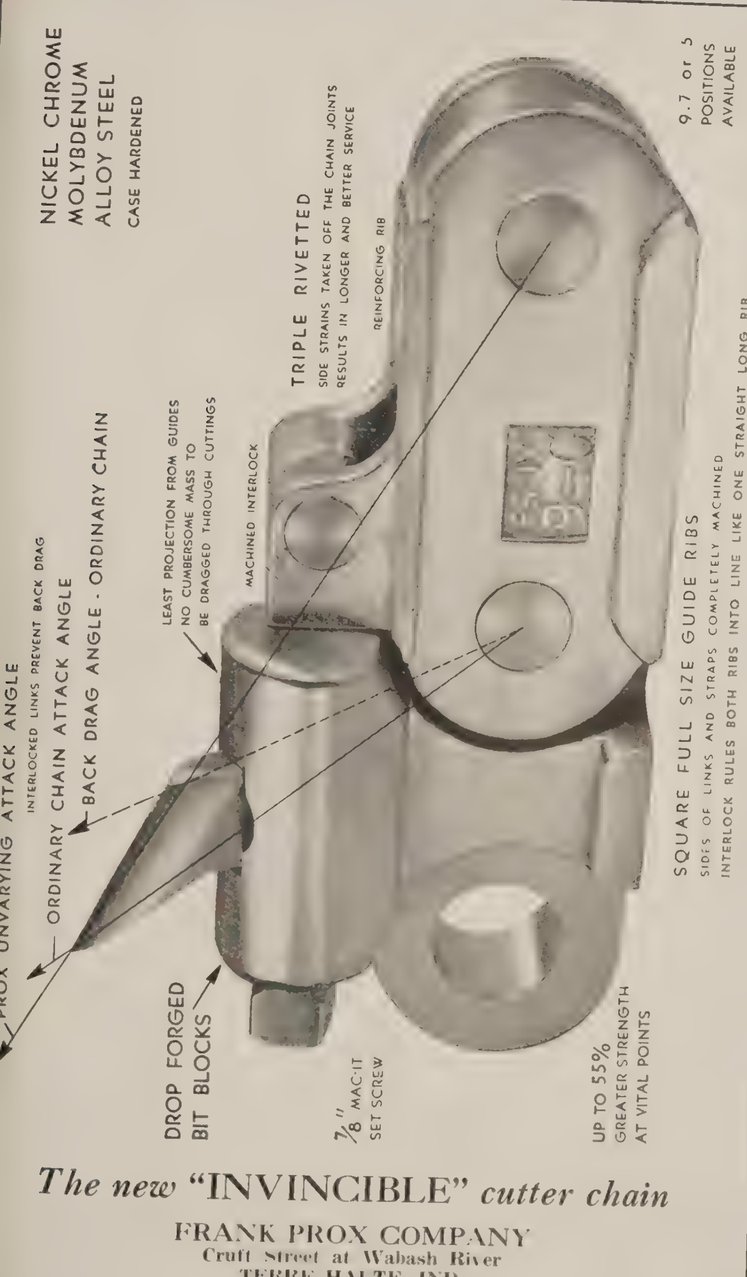
LISTEN: One of these cars operates on an outside haul of 3,800 ft. long with 0.65% (only a little over ½ of 1%) grade in favor of the loads. The motorman starts the trip, pulls down the trolley pole, and the trip then pushes the locomotive down to the dump.

Watt Trucks With Anti-Friction Bearings—Of Course

WATT CAR & WHEEL CO.

Barnesville, Ohio
Chicago Agents: B. E. Schonthal & Co., 59 E. Van Buren St.


PROX UNVARYING ATTACK ANGLE
INTERLOCKED LINKS PREVENT BACK DRAG
ORDINARY CHAIN ATTACK ANGLE
BACK DRAG ANGLE - ORDINARY CHAIN
LEAST PROJECTION FROM GUIDES
NO CUMBERSOME MASS TO
BE DRAGGED THROUGH CUTTINGS
MACHINED INTERLOCK
TRIPLE RIVETTED
SIDE STRAINS TAKEN OFF THE CHAIN JOINTS
RESULTS IN LONGER AND BETTER SERVICE
REINFORCING RIB
NICKEL CHROME
MOLYBDENUM
ALLOY STEEL
CASE HARDENED
9.7 or 5
POSITIONS
AVAILABLE
SQUARE FULL SIZE GUIDE RIBS
SIDES OF LINKS AND STRAPS COMPLETELY MACHINED
INTERLOCK RULES BOTH RIBS INTO LINE LIKE ONE STRAIGHT LONG RIB
DROP FORGED
BIT BLOCKS
7/8" MAC-IT
SET SCREW
UP TO 55%
GREATER STRENGTH
AT VITAL POINTS

The new "INVINCIBLE" *cutter chain*

FRANK PROX COMPANY
Cruft Street at Wabash River
TERRE HAUTE, IND.

COALMASTER

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Our objective is to place your mine on a more economical drilling basis and to obtain for you more satisfied drillers.

To accomplish this end most effectively, we make the largest line of drill bit equipment available.

These are but two of the reasons why more Illinois and Indiana mines use Coalmaster Drill Bit equipment than any other make.

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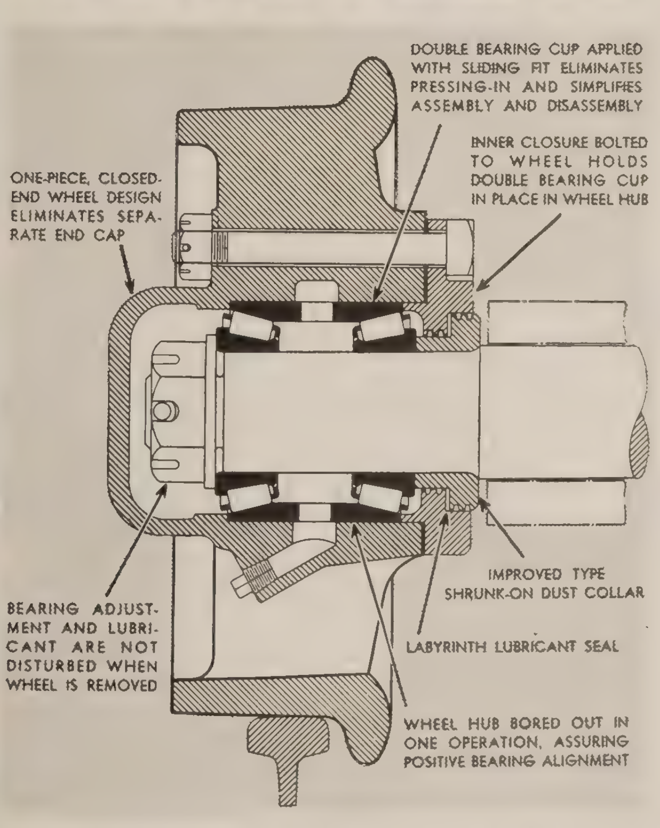
Central Mine Equipment Company

"The Drill Bit People"

SAINT LOUIS

TIMKEN


DOUBLE BEARING CUP APPLIED WITH SLIDING FIT ELIMINATES PRESSING-IN AND SIMPLIFIES ASSEMBLY AND DISASSEMBLY
INNER CLOSURE BOLTED TO WHEEL HOLDS DOUBLE BEARING CUP IN PLACE IN WHEEL HUB
ONE-PIECE, CLOSED-END WHEEL DESIGN ELIMINATES SEPARATE END CAP
IMPROVED TYPE SHRUNK-ON DUST COLLAR
BEARING ADJUSTMENT AND LUBRICANT ARE NOT DISTURBED WHEN WHEEL IS REMOVED
LABYRINTH LUBRICANT SEAL
WHEEL HUB BORED OUT IN ONE OPERATION, ASSURING POSITIVE BEARING ALIGNMENT

The Dominant Mine Car Bearing

Approved and used by 1,000 mine operators. Saves hauling time. Cuts operating and maintenance costs. Lengthens car life. Illustration shows the revolutionary new Timken mounting—the result of more than 10 years experience in the mine car field. There is no substitute for the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken alloy steel in mine cars. It pays to specify Timken-equipped.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

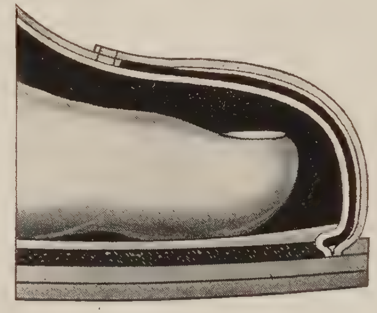
TIMKEN *Tapered Roller* BEARINGS

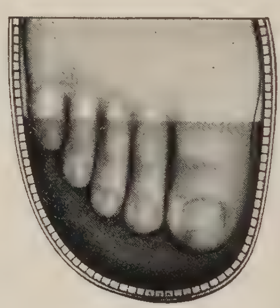
They are Ready to Ship

NOW!

Brownbilt SAFETOE SHOES

are carried in stock in 18 patterns—styles and types to meet the needs of workers, foremen and superintendents.





As clearly illustrated above Brown-bilt SAFETOE shoes are constructed over specially designed lasts to provide comfort for the wearer. There is ample "toe clearance" at the top and sides.

The Rust-proofed tempered, steel cap withstood average compression of 5,054 load pounds in laboratory test.

Write for illustrations, descriptions and prices. Special SAFETOE representative will call on request.

Brown Shoe Company

SAFETOE DIVISION

MANUFACTURERS **ST. LOUIS, MO.**

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JOHN FUHRER, Sec.-Treas.
T. B. CLEMENT, Vice.-Pres.

EGYPTIAN TIE & TIMBER COMPANY

1803-07 Railway Exchange Bldg.
St. Louis, Mo.

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Mine Timbers, Cross Ties, Lumber and Piling

THE MSA COMFO RESPIRATOR

(Reg. U. S. Patent Office)

. . . like breathing through a handkerchief, yet sure protection against microscopically fine dust . . . *and less than 5 ounces in weight*

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Here's a REAL dust respirator, developed by experts on dust hazards. The MSA Comfo Respirator, officially approved by the U. S. Bureau of Mines, combines these outstanding features: exceptionally low breathing resistance . . . high protective efficiency . . . lightweight comfort . . . easy, snug-fitting adjustment . . . absolute non-interference with goggles or other headgear . . . low first cost . . . the longest service life per filter . . . the lowest filter replacement cost.

Miners CAN and DO wear Comfos all day long without discomfort. Investigate these proved dust respirators,—write for the MSA Comfo Respirator Bulletin, No. CR-1.

Mine Safety Appliances Company

Braddock, Thomas & Meade Sts., Pittsburgh, Pa.

District representatives in the principal cities.

M. S. A. Products include Breathing Apparatus . . . Inhalators . . . Masks of all types . . . Gas Indicators . . . Gas Detectors . . . M. S. A. Safety Goggles . . . M. S. A. Protective Hats and Caps . . . Edison Electric Cap Lamps . . . Safety Clothing . . . First Aid Equipment . . . Submarine Escape Apparatus . . . Descriptive Bulletins sent on request.

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Perforated Metals

We manufacture Coal Mining Screens of every type—flat—flanged end—cylindrical or special shape. Any size or style screen in whatever thickness of metal you desire. Perforated with the exact size and style of holes you require. We are supplying Coal Screens to many leading coal mines—made to their exact requirements and specifications.

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CHICAGO PERFORATING CO.
2445 W. 24th Pl., Chicago, Ill.

MT. VERNON CAR MFG. CO.

Mt. Vernon, Illinois

Manufacturers of

Mining Cars
Mining Car Wheels
Mining Car Trucks
Mining Car Axles
Shaker Screens

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We also specialize in repairing mine car equipment.

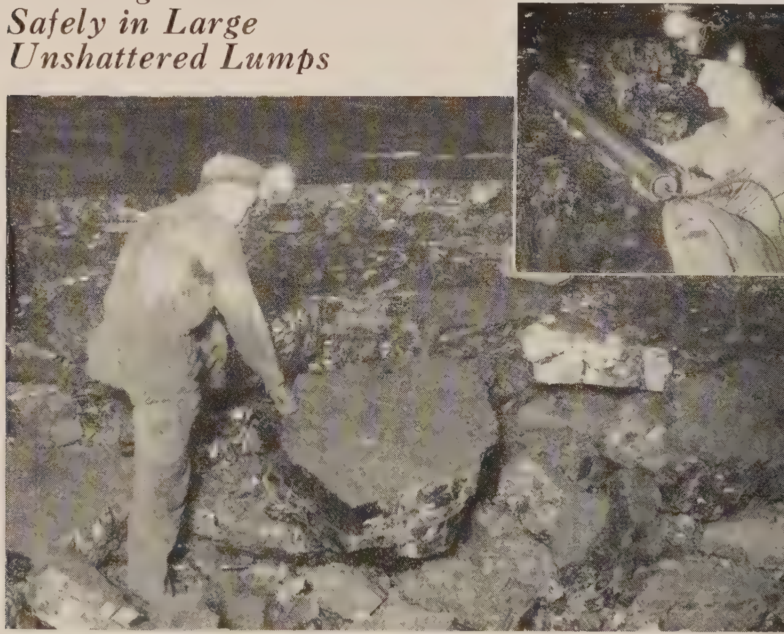
THE Koppers-Rheolaveur Washery recently installed at the Fidelity Mine of the United Electric Coal Companies near Duquoin, Illinois, is now efficiently washing 600 tons of 3 in. x 0 in. coal per hour. Carpenter Mechanical Dryers are drying minus 5-16 in. coal. Premium coal in all nut and screenings sizes is produced for domestic and steam uses. This new plant was designed to fully utilize the existing tipple and other present equipment at the Fidelity Mine,—a typical example of Rheolaveur adaptability and Koppers-Rheo experience.

* * *

Koppers-Rheolaveur Company
Pittsburgh, Pa.
McCormick Bldg., Chicago, Ill.

Two views of new Koppers-Rheo Washery, Fidelity Mine of The United Electric Coal Companies.

Breaking Down the Coal Safely in Large Unshattered Lumps



SULLIVAN (Non-explosive) AIRDOX

A cartridge placed in the usual drill hole is charged with compressed air, which when released pushes the coal forward instead of shattering it. Safe, perfectly controlled action. Produces premium lump coal.

A test has shown 28.6% lump by air shooting compared with 11.55% by explosive—with a big reduction in 2-inch screenings.

The Sullivan WK-44 (4 stage compression) self-propelled mine car does the charging. The cartridge may be used repeatedly. Does not alter present mining set-up. Fewer working places, less timbering and a safer mine.

SULLIVAN

MACHINERY COMPANY

843 Wrigley Bldg. Chicago, Ill.

- for all shapes, sizes and qualities of STEEL and for the latest and most complete stocks of MINE SUPPLIES—

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- YALE hoists and trolleys.
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- and, of course, BOLTS, capscrews, nuts, washers, nails, spikes.
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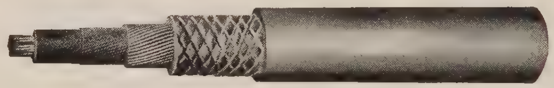

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SAVE MONEY

with this TOUGH, LONG-LIFE CABLE

YOU can count on G-E mining cable to cut costs. It is the ideal cable for gathering-reel locomotives, mining machinery, and electric shovels. Try it out; we know it will show worth-while savings.

The Reason

The all-rubber jacket on G-E mining cable is tellurium-compounded, which makes it tough — tough as the tread of an automobile tire. Certain types have passed the drastic tests of the U. S. Bureau of Mines and endured such punishment as being run over 10 times by a 10-ton locomotive.

Cuts Costs

You can see how this cable can keep down your maintenance costs — by reducing replacements, preventing shutdown of power supply, shortening tie-up periods, and giving added protection to life and equipment.

All Types and Sizes

Tellurium-compound cable is available in the following types: single-conductor, two-conductor flat, two-conductor concentric, two-, three-, and four-conductor round, for voltages up to 11,000.

Braided types of G-E mining cable can also be furnished for 600-volt service. Ask about the new G-E loom-sheath-Glyptal cable, which has a life about 30 per cent longer than ordinary braided cable.

Electric Equipment of all Kinds

In addition to insulated cable of all types and sizes, General Electric manufactures mining locomotives and parts, motors and control, arc welders, circuit breakers, and many other types of electric equipment for mines. For complete information, address the nearest G-E sales office, or General Electric, Schenectady, New York.

520-27

GENERAL ELECTRIC

Filing No. 12

COMMERCIAL TESTING
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COAL

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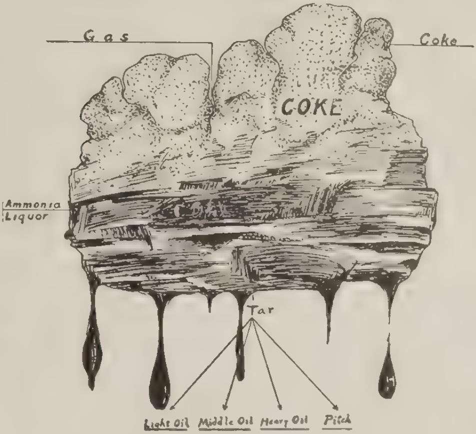

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PLANT
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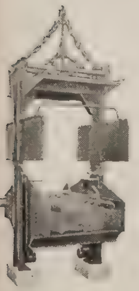
Dependability, plus Faster Hoisting
IS THE ANSWER TO SHORTER HOURS

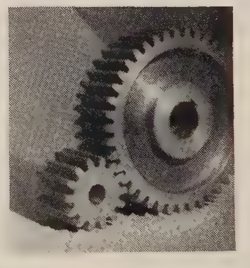


The Olson Automatic Self-Dumping Cage in the new OC-7 Type is absolutely positive in action and is the fastest cage unit ever built.

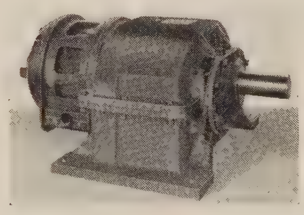
It will be real economy to make up for the shorter work week with faster, safer cages. Keep step with 1935 production demands with new Olson Cages.

EAGLE IRON WORKS
DES MOINES, IOWA

LEADS TO SAVINGS

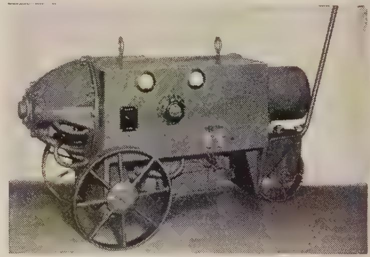


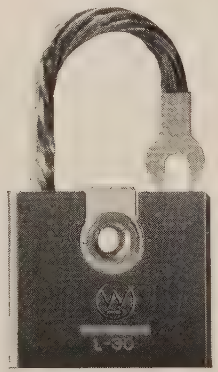
- **WESTINGHOUSE BP TOUGH-HARD GEARS AND PINIONS** wear four times as long as ordinary untreated gears and stand three times the load or impact.



- **WESTINGHOUSE "UNITARY POWER" GEAR MOTORS** save space, installation time and power costs. Important: Both motor and gears are designed and rated as a SINGLE UNIT, built by ONE manufacturer.

- **WESTINGHOUSE FLEXARC WELDERS** have saved mine shops thousands of dollars yearly in maintenance work. Simple to operate. Easy to move about. Weldomatic (automatic) equipment for building up locomotive wheels will save you plenty, too!





- **RENEWAL PARTS AND SERVICE.** Westinghouse Service Shops and complete stocks of high quality carbon brushes, motor coils, bearings, insulating materials and line materials are located nearby. Use the phone for quick deliveries!

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Westinghouse

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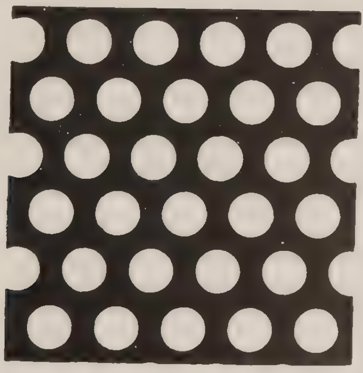

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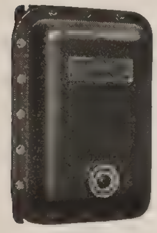
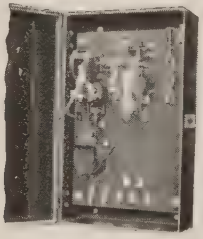
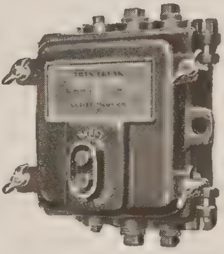
Mine Duty Electrical Equipment



Bul. 9586 Explosion-proof Across-the-line A. C. Starter.

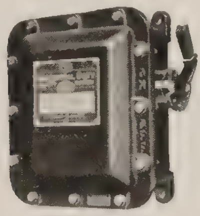


Mine Duty D. C. Across-the-line Automatic Starter.

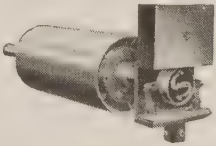


Bul. 9586 Starter in Dust-tight, Weather-proof Enclosure.

C-H Mine Duty Apparatus includes a complete line of starters for A. C. and D. C. applications in standard, dust-tight, and explosion-proof enclosures. The "Mine Duty" Starter shown above incorporates many features which make it particularly applicable to mine service.

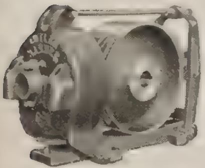


C-H Explosion-proof Safety Switch for Class I, Group D locations.



C-H Type "W" Magnetic Separator Pulley with many new design features.

C-H Safety Switches include a type and size to meet every requirement—they are made in standard dust-tight weather-proof, and explosion-proof enclosures. C-H Magnetic Separator Pulleys prevent damage to costly crushing, grinding, and stamping machinery.



C-H Type "M" Electric Brake.

C-H Electric Space Heater.

Other C-H Mine Duty Apparatus

Float Switches, Pressure Switches, Battery Charging Equipment, Automatic Sub-station Controllers, Automatic Hoist Controllers.

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PIONEER MANUFACTURERS OF ELECTRIC CONTROL APPARATUS

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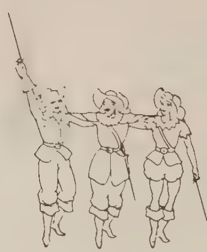
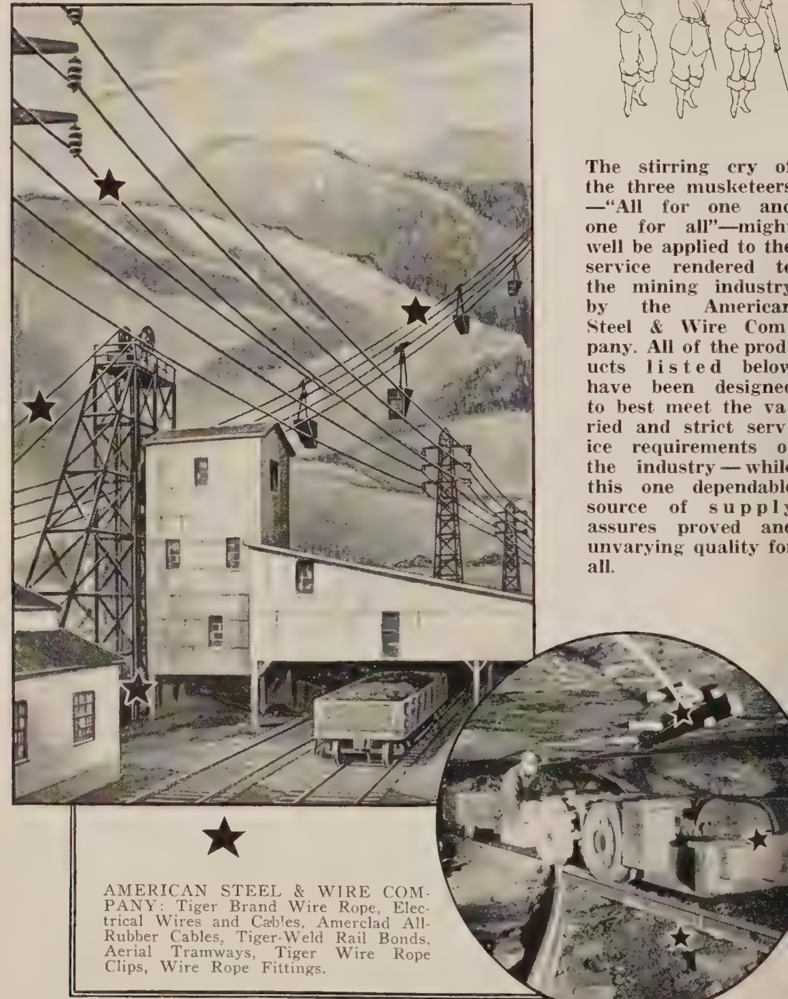
"ALL FOR ONE
ONE FOR ALL"



The stirring cry of the three musketeers —"All for one and one for all"—might well be applied to the service rendered to the mining industry by the American Steel & Wire Company. All of the products listed below have been designed to best meet the varied and strict service requirements of the industry — while this one dependable source of supply assures proved and unvarying quality for all.



AMERICAN STEEL & WIRE COMPANY: Tiger Brand Wire Rope, Electrical Wires and Cables, Amerclad All-Rubber Cables, Tiger-Weld Rail Bonds, Aerial Tramways, Tiger Wire Rope Clips, Wire Rope Fittings.

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United States Steel Corporation Subsidiar

Every Mining Operator

will find it worth while to investigate the merits of

P-G Steel Grid Resistors

For Locomotives and Mining Machinery

P-G Automatic Transfer Switches

For Locomotives

P-G Mine Duty Self-Starters

For D. C. Fan and Pump Motors

Write today! Tell us your problem! We will be glad to send you descriptive literature, and tell you about our free trial offer. No obligation whatever.

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This picture illustrates not only the P-G Transfer Switch and the P-G Grid Resistor, but the satisfaction of work well done that comes to the operator. He appreciates equipment that will "carry on"—and that means profitable operation for you.

Distributor of Universal Cast-Iron Pipe and Fittings

Try This

SPECIAL MINING MACHINE ROPE

You've used standard construction Yellow Strand and other B & B Ropes on mine hoists and inclines.

NOW, try "Flex-Set" *Preformed* Special Mining Machine Rope. The same high quality wire, but —the rope is limbered up by preforming. It handles more easily, is installed and broken in more quickly and safely. Less subject to fatigue, less apt to kink.

This company makes standard construction and "Flex-Set" Preformed Ropes in all grades for mining equipment of all types. Let us "prescribe" the rope best suited to your equipment.

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B & B WIRE ROPE

A TYPE FOR EVERY JOB
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STEAM SHOVEL COMPANY
MARION, OHIO, U.S.A.
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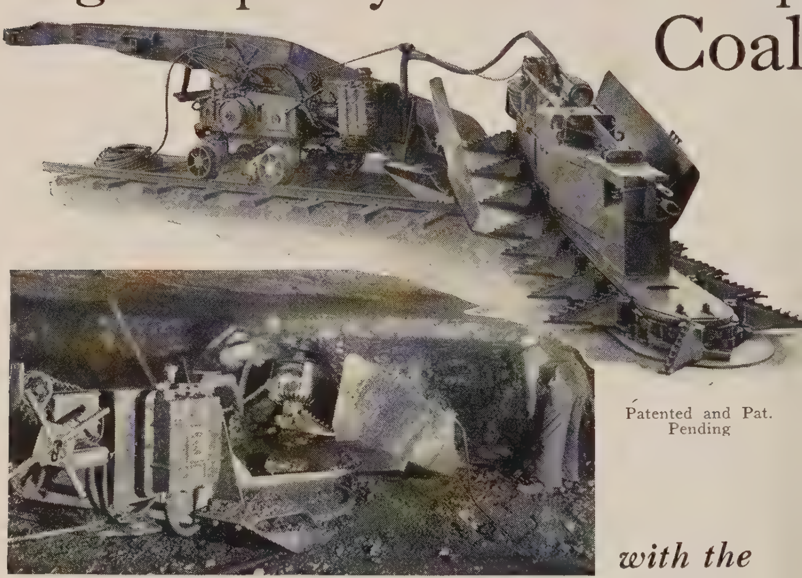
Proven PERFORMANCE!

The Marion Type 5560 with its splendid record of achievement in the Illinois Coal Fields is convincing evidence of Marion's knowledge of coal stripping requirements. This large stripping shovel has a dipper capacity of 20 cubic yards.

In addition, Marion builds—
Type 5320 . . . . . 8 to 12 cu. yd.
Type 5480 . . . . . 12 to 16 cu. yd.
—exclusively for coal stripping service.

THE MARION
STEAM SHOVEL COMPANY
Marion, Ohio, U. S. A.

High Capacity—More Lump Coal



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JEFFREY 44-D LOADER

JEFFREY
COAL MINE
EQUIPMENT

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Locomotives, Coal Cutters, Drills, Conveyors and Loaders, Fans, Tipple Machinery, Preparation Equipment.

The Jeffrey 44-D is a Track-type Coal Loader with a capacity of two tons per minute. Loads in coal with minimum height 48 in. above rail. Consists of a gathering conveyor and a discharge conveyor. The latter can be swung 45 degrees each side of center line—permits loading on a curve in room necks or cross cuts with boom always over car. Also hinged and supported on springs to allow vertical movement.

The Jeffrey 44-D Loader is easily maneuvered in both tramming and loading. Has centralized control—two 15 H. P. motors. Maintenance and power costs are low, and breakage of coal a minimum.

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THE safety steel box toes in Hy-Test Safety Shoes are not merely laid in between the cap and the vamp, but *anchored* in. This feature alone greatly increases the safety efficiency of Hy-Test Safety Shoes and is another reason for their popularity with an increasingly large number of industrial organizations. There's a Hy-Test Safety Shoe for every safety job. Safe and *comfortable*, Hy-Tests are easy to sell.

Without obligation to you, we will gladly send our free booklet, "The Whole Story About Safety Shoes."

HY-TEST
Safety Shoe Division

INTERNATIONAL SHOE CO.
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"LITTLE GIANT" COAL DRILLS, mounted, unmounted (Electric, Pneumatic).

"LITTLE GIANT" PERMISSIBLE ELECTRIC COAL DRILLS, mounted, unmounted.

MINE CAR COMPRESSORS, Electric Motor Driven.

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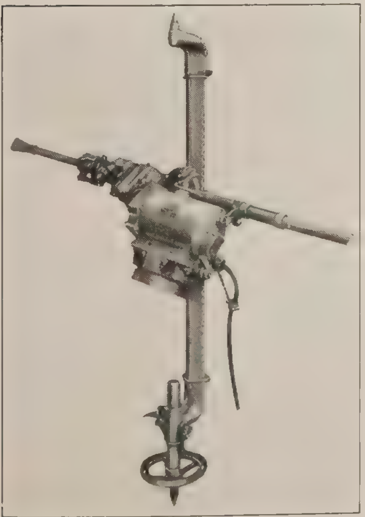
ELECTRIC AND PNEUMATIC DRILLS for Car Repair and Maintenance Work.

THE NEWEST "LITTLE GIANT" PERMISSIBLE COAL DRILLS



These new permissible drills are vitally important to every gaseous or dust-laden mine. Safety, fast drilling, speed, light weight and accessibility are some of the major factors that mean *Economy* and *Low Production* costs.

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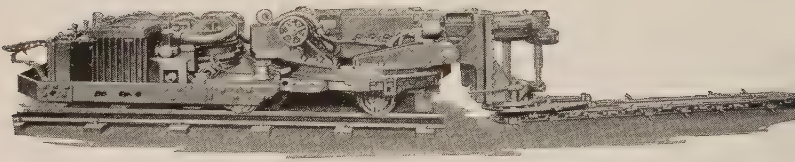
S. P. 1865.

Chicago Pneumatic Tool Company

6 East 44th St., New York **3655 Iron St. Chicago**

Modernize Your Undercutting With GOODMAN Mounted Bottom Cutters



Mounted Bottom Cutter

Three large producing companies in Illinois are using between 40 and 50 of these cutters and they are making tonnage and low upkeep records.

More Places Cut — In Less Time With Less Labor — And Greater Safety

Standard — Low Vein
Cuts a Smooth Bottom
Self-Propelled — Self-Contained
8 Inches Below Rail Tops to 7½ Inches above
Cuts in either direction with Gear Controlled Feed

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Complete Details and Specifications in Book M-292.
Yours Upon Request!

GOODMAN MANUFACTURIN
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HALSTED ST. at 48
CHICAGO - - - IL
Locomotives - Loaders - Coal Cutter
PITTSBURGH-WILKES-BARRE-HUNTINGTON-BIRMINGHAM-ST LOUIS-DENVER-LOS ANGEL

Almost one HALF CENTURY of progress
in Mine Ventilation

Fans and Blowers for All Purposes

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Special Representatives

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With the KW BATTERY CO., service is more important than sales. Users must get good results from KW batteries for they have the unqualified privilege of exchanging for new batteries whenever in their opinion performance is no longer 100 per cent.

Obviously we can prosper only by making KW batteries so good that these exchanges are many months apart. The financial strength of the KW Company and the extensive use of KW service by large operators both are conclusive evidence of KW service.

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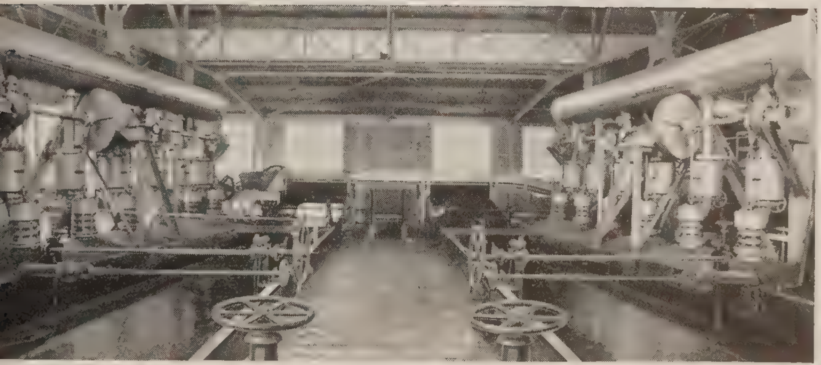

Link-Belt Simon-Carves washing system handling all coal from 4" to 0", at Midland Electric Corp., Farmington, Ill. Twin units, each having a capacity of 200 tons per hour.

...of clean coal, is the annual combined rated capacity of the 304 Link-Belt Simon-Carves washing units which have been sold for world-wide service. (This is based on a combined hourly capacity of 20,532 tons, 48 hours per week.) A great many of these are repeat orders.

These many installations, cleaning all varieties and characteristics of coals, have fully demonstrated the efficacy of the Link-Belt Simon-Carves system. They have proved that it is low in capital outlay, depreciation and power consumption; requires minimum supervision, repairs and renewals, and that it scientifically cleans coal thoroughly and completly, with a minimum loss of yield.

INK-BELT PRODUCTS INCLUDE: *Complete Coal Tipple Equipment · Link-Belt Simon-Carves asheries · Dry Cleaning Equipment · Dust Extraction Equipment · Elevators and Conveyors of all pes · Screens (Vibrating, Shaking, Revolving, etc.) · Picking Tables · Loading Booms · Feeders rushers · Car Dumpers · Chains (Malleable Iron, Promal or Steel) · Shovels-Cranes-Draglines lverstreak Silent Chain Drives · Silverlink Roller Chain Drives · Speed Reducers · Motorized educers · Variable Speed Transmission (P.I.V. Gear and V.R.D. types) · Complete line of Accessories. Send for catalog.*

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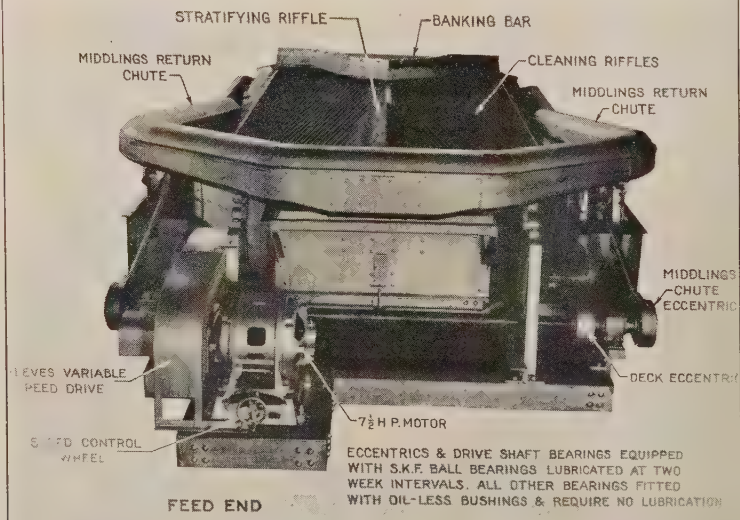
PLE AND CLEANING EQUIPMENT

AMERICAN COAL CLEANING CORPORATION
Welch, W. Va.

AMERICAN
Pneumatic Process for Cleaning Coal Without Adding Moisture

Originators of the Dry Coal Cleaning System, (under Sutton, Steele & Steele, Inc., patents) including Dedusting and Dust Collection in the same operating process. Eliminates the dust nuisance. Insures a uniform moisture and ash content in any coal.

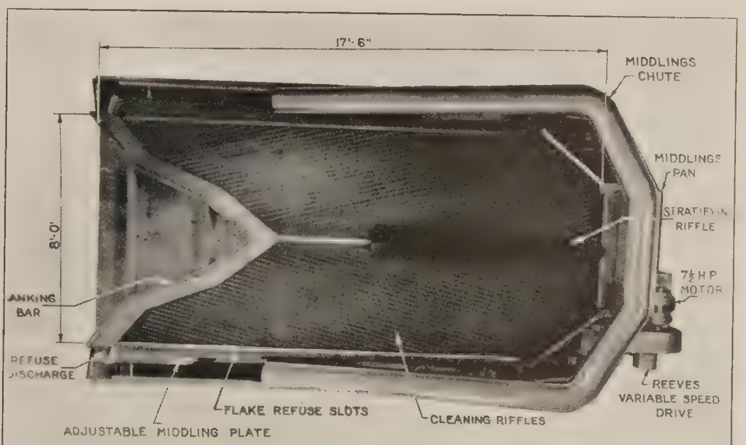


ECCENTRICS & DRIVE SHAFT BEARINGS EQUIPPED WITH S.K.F. BALL BEARINGS LUBRICATED AT TWO WEEK INTERVALS. ALL OTHER BEARINGS FITTED WITH OIL-LESS BUSHINGS & REQUIRE NO LUBRICATION

TYPE [illegible] SIZE RB, AMERICAN PNEUMATIC SEPARATOR

AMERICAN COAL CLEANING CORPORATION
WELCH, W. VA.

"The Original Basic Process for Cleaning Coal Without Adding Moisture"



PLAN VIEW
TYPE "Y", SIZE RB, AMERICAN PNEUMATIC SEPARATOR

AMERICAN COAL CLEANING CORPORATION
WELCH, W.Va.

The AMERICAN Pneumatic Process, of which we are the originators, is only 14 years old. Its growth and development has been rapid. Installations are to be found in every important coal producing State of the Union and in every coal producing country of the world, excepting China, Japan and New Zealand. The total installed capacity is 40,000,000 tons annually.

Coal producers of importance using this system have not only maintained, but actually increased their coal sales and realization, since the installation of the AMERICAN Pneumatic Coal Cleaning Process, which has revolutionized the Art of Mechanical Coal Cleaning.

"The Original Basic Process for Cleaning Coal Without Adding Moisture"

The advantages derived from cleaning coal with the AMERICAN Pneumatic Process are:

FIRST: Reducing the ash to a uniform and desired percentage.

SECOND: A lowered sulphur and increased fusion temperature.

THIRD: Increased B.T.U. heat value.

FOURTH: Reduction of moisture in the cleaned product to any desired content.

FIFTH: Increased range in the prepared sizes for both domestic and commercial uses.

SIXTH: Where impurities are embedded in the coal, such as most Illinois Coals, it can be pulverized, crushed or disintegrated to a size range 1/8″ to 0″ and successfully dry cleaned, and then made into metallurgical and domestic coke.

SEVENTH: Dedusting of the coal up to 1/16″ size during the cleaning operation without additional equipment or cost.

EIGHTH: One hundred per cent dust collection. The dust collected is separated into two sizes.

NINTH: Low investment and operating costs that return a profit.

TENTH: Flexibility in control of ash content in cleaned coal governed by percentage of coal returned for retreatment with anti-gravity return chutes without interrupting the operation of the plant.

Our system is automatic in operation, and adjustments can be made instantly. Can be operated 24 hours per day. Design and construction based on sound engineering principles and more than 30 years coal betterment experience. We are prepared to make and furnish complete laboratory tests on any coal, design and erect the structure and make complete installation or adapt the system to existing facilities, and furnish you efficient cleaning at a less cost per ton than any now known method.

Dedusting, Dust Collection and Drying coal are inseparable steps in the Dry Cleaning Process.

"The Original Basic Process for Cleaning Coal Without Adding Moisture"

Our latest installation showing AMERICAN Pneumatic Separator at Crerar Clinch Coal Co. No. 14 Mine, DuQuoin, Illinois.

Competent Engineering and Laboratory advice will be furnished. Submit us your problems and we will assist you in their solution.

Separators erected and assembled in our shops at Kingsport, Tennessee. Laboratory, Engineering and General offices, Welch, West Virginia.

Your Inquiries Solicited

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AMERICAN COAL CLEANING CORPORATION

Welch, W. Va.

"The Original Basic Process for Cleaning Coal Without Adding Moisture"

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on

DEMING

Whether it is a series of small gathering pumps, a large centrifugal or any size or type between—you can be sure Deming has the equipment to fit the job.

Today, Deming offers so complete a line of pumps that many mine owners are standardizing on this equipment—dealing with one competent organization which can fill every pump requirement. And, at the same time these users are getting the most for every dollar invested in pumps.

Standardize on Deming and you can rest assured that efficiency and economy will be reflected in your pumping operations.

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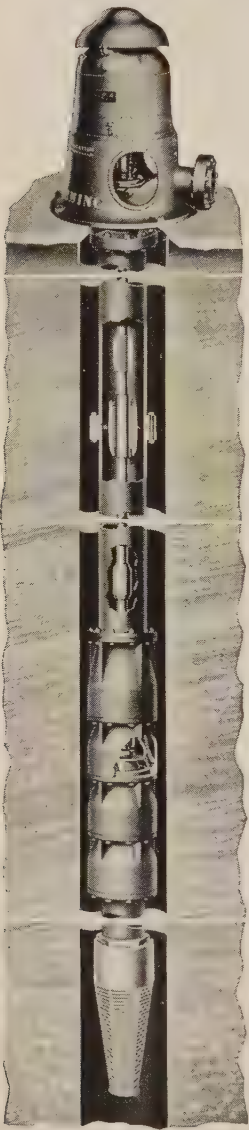
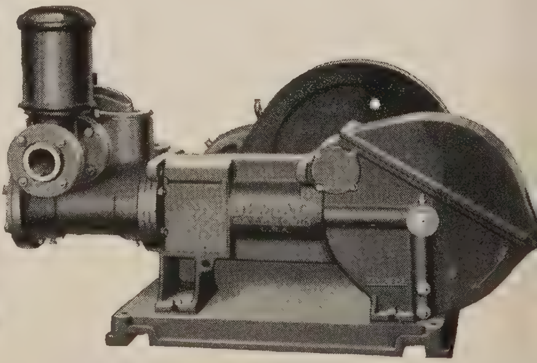


Deep Well Turbine

This type of pump is becoming increasingly popular for mine dewatering.



"Oil-Rite" Double Acting Gathering Pump

Can be furnished with all chrome water end for use in handling especially bad water.

30% - 50%

GREATER RESERVE CAPACITY

with **TYSON** *Cageless*

TAPERED ROLLER BEARINGS

- Rapidly growing numbers of Mine Cars are equipped with TYSON *Cageless* Tapered Roller Bearings, for all tests prove their greater capacity means but one thing to the operator—a lower cost per ton of coal mined. From 3 to 9 *more* tapered rolls per bearing permits TYSON to build into every bearing 30% to 50% greater reserve capacity. TYSON bearings are interchangeable, size for size, with other tapered roller bearings. Data sheets giving TYSON bearing recommendations for different capacity cars and recommended designs for mountings will be sent on request.

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The JOY 10-BU

JOY adds another important page to Coal Mining history with the Joy 10-BU Loader. This heavy duty, rugged loader offers new "highs" in tonnage loaded and new "lows" in cost of production. Guaranteed capacity *four tons per minute.* Joy service now includes a complete program cutting, loading and conveying. Consult Joy Engineers for the answer to your mechanization problems.

The JOY Manufacturing Company

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internal lubrication

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Use this Better Wire Rope PREFORMED where the very best in Wire Rope is wanted.

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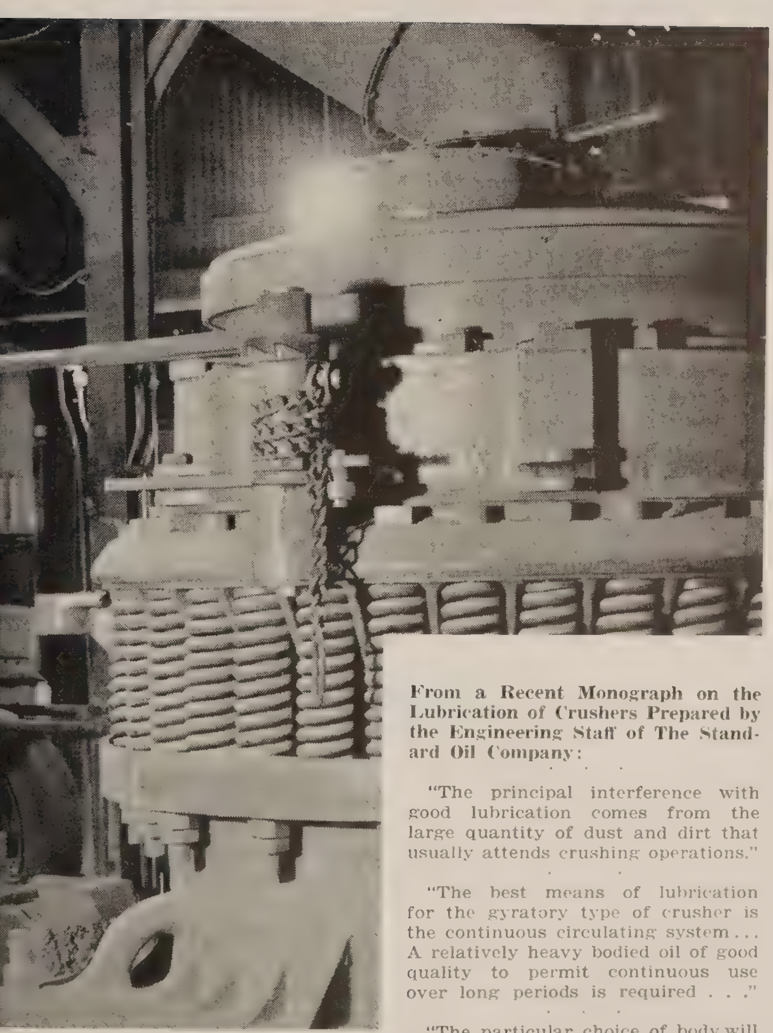
Refer to Keystone Coal Mining Catalogs for complete information on Macwhyte Wire Rope for Mining.



From a Recent Monograph on the Lubrication of Crushers Prepared by the Engineering Staff of The Standard Oil Company:

. . .

"The principal interference with good lubrication comes from the large quantity of dust and dirt that usually attends crushing operations."

. . .

"The best means of lubrication for the gyratory type of crusher is the continuous circulating system . . . A relatively heavy bodied oil of good quality to permit continuous use over long periods is required . . ."

. . .

"The particular choice of body will depend on the particular make and model of crusher involved and the season of the year, where low temperatures are encountered."

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"In cold weather it is a good plan to start up with no load, letting the oil warm up to procure good circulation before imposing heavy loads on the bearings and gears."

Wherever the odds favor breakdowns or lubrication problems are difficult, call in he Standard engineer. He cuts Costs.

For practical Monographs on your Lubrication Problems write to the

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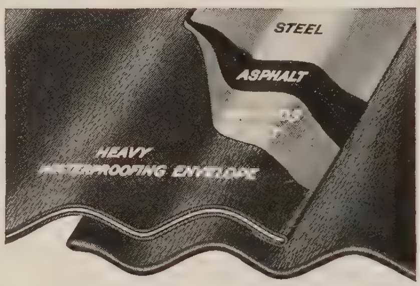
RPM is a corrugated roofing and siding sheet completely and permanently encased in a system of patented corrosion-proof coverings applied at the factory. These coverings become part of the sheet itself and render it immune to corrosive agencies.



Robertson Protected Metal

Cutaway view showing protective layers which cover the steel and prevent corrosion: (1) asphalt; (2) asphalt-impregnated asbestos felt; (3) heavy waterproofing envelope. Lower sheet illustrates manner in which edges are protected.

RPM is being used successfully in the coal and by-product coke industries for:

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- Conveyors
- Power-houses
- Washers
- Pump-houses
- Sheds
- Hoist-houses
- Scale-houses
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- Coke-screening plants
- Salt Storage Buildings
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RPM is protected by U. S. Patent No. 1,277,755,
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WORLD WIDE BUILDING SERVICE

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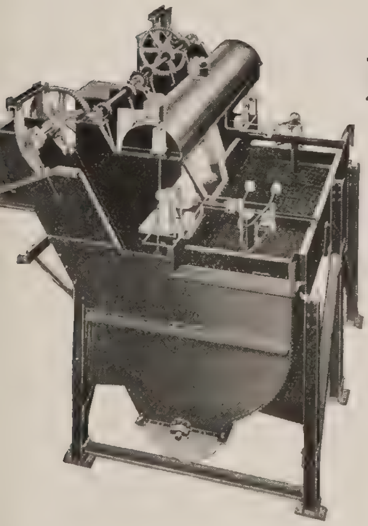
Convert Ordinary Coal into Premium Fuel



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McNALLY-NORTON WASHER

Uniformly clean coal — no matter how much the impurities vary in the raw coal —that is the achievement of the McNally-Norton Patented Automatic Washer. Hand picked coal cannot compare in sales value with washed fuel. McNally-Norton Washed Fuel appeals to all dealers and users— it is premium fuel!

The constantly increasing number of McNally-Norton plants in the United States is the best testimony of the success of the McNally-Norton System. McNally-Pittsburg engineers will gladly submit, without obligation, answers to any questions regarding estimates of cost and expected results of the McNally-Norton Coal Washer at your mines. These figures are backed by results over a period of years in America and England. Every progressive mine operator should have on file the McNally-Pittsburg Data Book on coal cleaning by the McNally-Norton Automatic System. Write for your copy today.

The McNally-Pittsburg Line Automatic Coal Washers, Screens, Crushers and Breakers, Picking Tables and Loading Booms, Elevators and Conveyors, Rotary Car Dumps. Complete facilities for designing, manufacturing, and erecting complete coal tipples. Send for McNally-Pittsburg quotations on any equipment for handling and preparing coal.

THE McNally-Pittsburg MFG. CORP.
DESIGNERS MANUFACTURERS ERECTORS OF COMPLETE COAL TIPPLES AND WASHERIES
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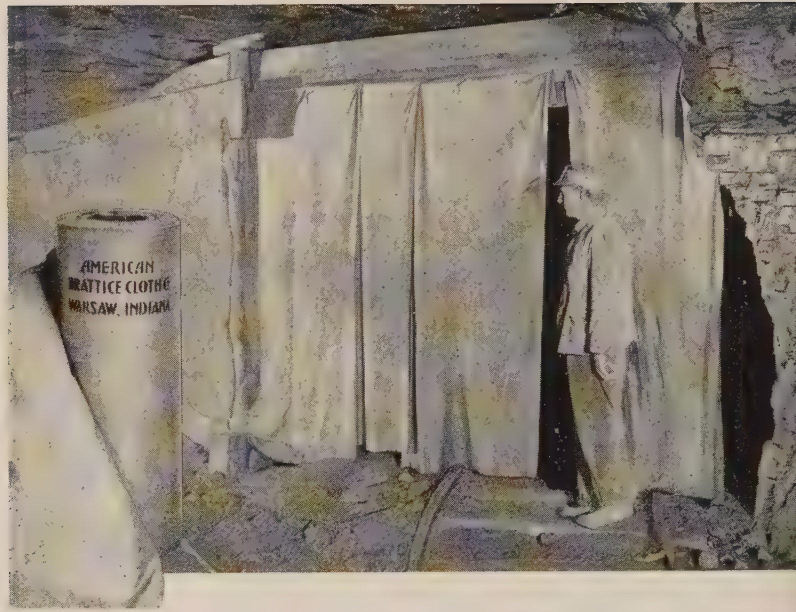

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Manufactured from high grade Jute Canvas and Cotton Duck

SUPPLIED IN SIX GRADES

"ABC" Special Double Warp Tarpaulin—Extra Heavy—Constructed of tightly twisted JUTE yarns, high in tensile strength. Reduces air-leakage to a minimum, especially when used as "flies."

"ABC" No. 1 quality. This medium priced jute brattice is very popular with the trade. Very closely woven, durable and economical.

"ABC" No. 3 quality. This grade is uniformly and closely woven and has proven very economical and practical. Slightly lighter in weight than "ABC" No. 1 quality.

"ABC" No. 7 quality Cotton Duck. This excellent brattice is well constructed and will average about 15 ounces in weight. It is without porosity and an absolute reflector of air currents.

"ABC" No. 27. This quality is the same as our "ABC" No. 7, but averages two (2) ounces heavier in weight. It is AIR-TIGHT.

'ABC" No. 17. This grade of fire-proofed Cotton Duck is made on an extra heavy duck base. Recommended for use on main haulage roads. Our special treatment adds to its tensile strength. It is air-tight and will withstand a lot of hard abuse.

We are also exclusive manufacturers of "MINE-VENT" Flexible Ventilation Tubing and patented Demountable Couplings for Auxiliary Ventilation. Latest and first improvement in many years.

AMERICAN BRATTICE CLOTH COMPANY
WARSAW, INDIANA

Agencies: Salt Lake City, Denver, Chicago, Birmingham, Huntington, Pittsburgh, Wilkes Barre, Seattle, Eagle Pass and other mining centers.

RYERSON STEEL AND TOOLS

for the Coal Mining Industry

When the mines need steel for maintenance or new construction, quick service is essential. Whether it is a large quantity or only a bar, a sheet or a few bolts, your order to Ryerson is shipped immediately. No waiting—no delay. Ryerson service also includes portable electric tools, jacks, hack saws, pipe threaders and other metal working tools.

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An unusually large stock of the heavier structural sections including special wide flange structural shapes

Cold Finished Steel Bars

Flats, rounds, squares and hexagons in various analyses. Triple inspected for accuracy, straightness and finish.

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A complete range of both structural and bar sizes in all standard sections; also galvanized angles, ship and car channels, etc.

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Boiler tubes, ferrules, flanges, hangers, lugs, crabs, hand holes, braces, nozzles, patch bolts and other allied products are in stock.

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Standard new rails with all accessories—splices, spikes, track bolts, etc.—are in stock for immediate shipment.

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Special rods adapted to welding the various materials and also equipment for both acetylene and electric arc welding

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Steel plates U.M. and sheared; high carbon plates, Firebox steel, copper bearing, Armco Ingot Iron and diamond floor plates stocked

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Special grades of tool steel for every shop requirement are carried in stock. Also tool steel sheets, tool holder bits, etc.

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—The unstaining, unrusting, untarnishing nickel chrome alloy that is being adopted for many purposes in all lines of industry. Large and complete stocks

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Standard grades and sizes of chain, special chain for cranes and steam shovels, grab hooks and similar products can be shipped at once

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Various grades of alloy steel bars heat treated and ready for use, in a wide range of sizes, including Nikrome, Ryco, etc.

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Ryerson Machinery Division can meet all your requirements for machine tools, metal working equipment and small tools. Write for descriptive literature

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Let Us Figure on Your Next Requirements

TRU·LAY
Preformed
IS
CONSISTENT WIRE ROPE

ND HERE IS A SERVICE RECORD TO PROVE IT

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COMPETITIVE
ON-PREFORMED
HOIST ROPES

292,778 tons
307,501 tons
109,629 tons
148,937 tons
231,547 tons
210,886 tons
430,700 tons
511,713 tons
380,566 tons
260,247 tons
283,519 tons
315,502 tons
175,540 tons
112,752 tons
247,988 tons
362,707 tons
449,342 tons
414,638 tons

AVERAGE: 291,471

TRU-LAY
Preformed
HOIST ROPE

402,326 tons	408,661 tons
304,449 tons	377,435 tons
493,058 tons	490,797 tons
306,753 tons	478,395 tons

AVERAGE: 407,734

All ropes were of the same size, construction, lay and grade. All ropes used under identical operating conditions.

TRU-LAY Preformed Wire Ropes gave 71.4% INCREASED TONNAGE.

Note, in this interesting record, that *one non*-preformed rope gave exceptional service, and that three others gave very creditable service. But *non*-preformed rope is inconsistent. TRU-LAY PREFORMED wire rope is *consistent* rope. As this record proves, you can *depend* on TRU-LAY.

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400 West Madison Street, Chicago
Headquarters: Wilkes-Barre, Pennsylvania
An Associate Company of the American Chain Company, Inc.

TRU·LAY *Preformed* Wire Rope

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Distributing Nationally Known Electrical Products to the

MINING INDUSTRY
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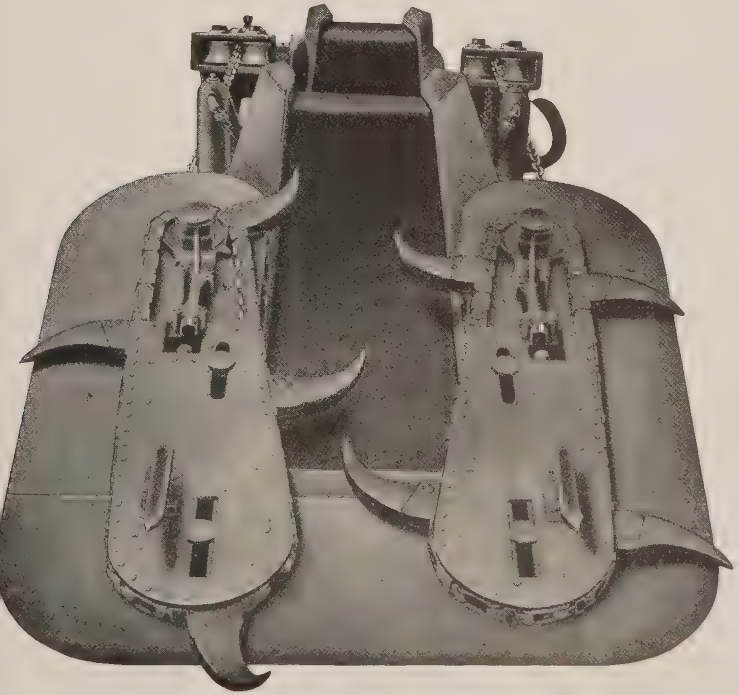
Strong and Powerful

Loads Out those Tight Entry Shots Perfectly



Pat. No. 1,904,355 and Other Patents Applied For.

Clarkson Manufacturing Company

NASHVILLE, ILL.

FLEXIPIPE

A flexible tubing that carries air anywhere. Used extensively in underground mine and tunnel development work.

Especially adapted for driving single entries long distances.

Write for the free booklet.

"Better Ventilation—
Lower Production Costs"

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The
Original
makers of
FLEXIBLE
Air Tubing

St. Louis,
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EXPLOSIVES

FOR COAL MINING

BLACK POWDER

Granular Form. If conditions require the use of Black Powder in your mines, there is a granulation of DU PONT BLASTING POWDER suited to your requirements. Uniform in quality, dependable in action and available whenever needed.

Pellet Form. Blasting powder compressed into cartridge form of uniform dimensions, and the pellets composed of standard granulations adapted to coal mining in the bituminous areas. Simplified loading practices, reduction in powder consumption and greater safety follow the adoption of DU PONT PELLET POWDERS.

PERMISSIBLE EXPLOSIVES

The names MONOBEL, DUOBEL and GELOBEL identify the permissible explosives made by du Pont for coal mining. Each group contains sufficient varieties to provide the type of explosive exactly suitable to mining conditions in your mines. For economical performance, required production and improvement in mining conditions, shoot DU PONT Permissible Explosives.

BLASTING ACCESSORIES

For assurance of most satisfactory performance of DU PONT EXPLOSIVES, always use detonators and other blasting accessories made by DU PONT. Do not expect satisfactory and economical action from your explosives if they are subjected to inefficient detonating agencies. Look for DU PONT on case, cartridge or carton when you buy explosives and blasting accessories.

E. I. du Pont de Nemours & Co., Inc.

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FROM Alaska to Chile, from Spitzbergen to New Zealand, wherever there are coal or metal mines, there is a decided preference for O-B materials; a preference which is based soundly upon dependability. It is not unusual for O-B Hangers and clamps to take the punishment of severe mine service for 20 or 25 years without any attention whatsoever. While the life of trolley wire splicers and frogs is largely dependent upon local mining conditions, there are many cases on record where these O-B devices have given years of trouble-free service.

Such performance means low maintenance costs, continuous haulage and greater profits. Take advantage of this "profitable dependability" by specifying O-B on your next order for overhead materials, rail bonds, or safety and control equipment.

1727M

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Mansfield, Ohio, U. S. A.

Canadian Ohio Brass Co. Limited Niagara Falls, Ontario, Canada

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Atlanta · Dallas · Los Angeles · San Francisco · Seattle

LAY·SET

MEANS MORE TONS

Three operators of Illinois mines were lunching at the Chicago Club recently—and talking "shop" as usual. The conversation turned to equipment—and wire rope. One operator raised the objection of price, whereupon another operator retaliated with: ". . . Of course LAY-SET Preformed Wire Rope costs more. It's preformed. But Lay-Set means more tons. The increased tonnage from Lay-Set is all out of proportion to the price differential. We've proved it."

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Thank you, Mister Operator. We wish we had permission to publish your name. . . . However—LAY-SET Preformed Wire Rope has long since proved its superiority to scores of Illinois operators. And in all mining jobs too, whether it be as shaft hoist ropes, on mining machines, as car pullers, car retarders, drag lines, on rotary dumpers, shovels, or any other operation.

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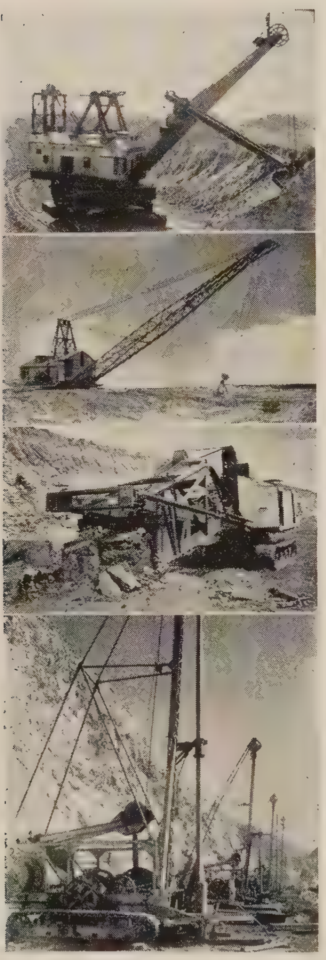

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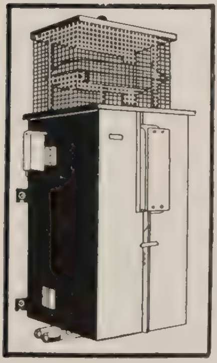

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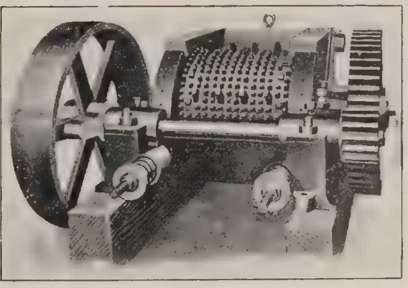

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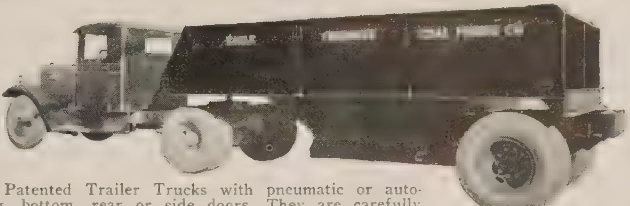

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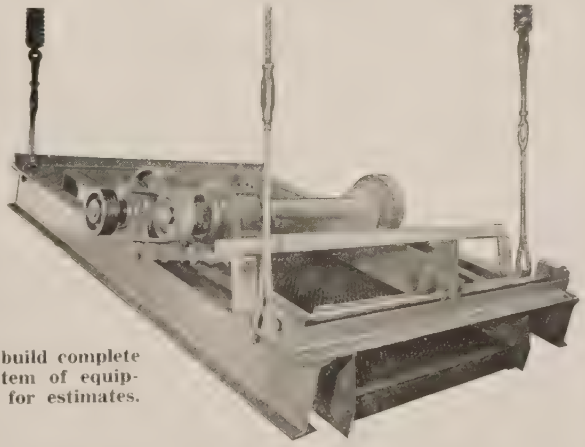

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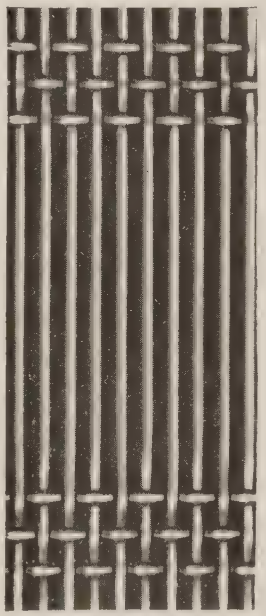

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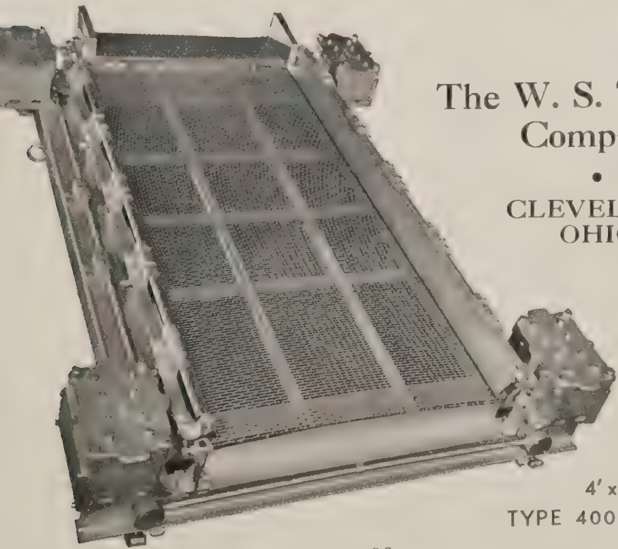

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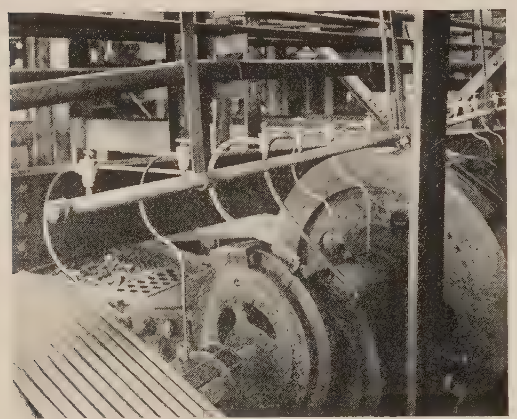

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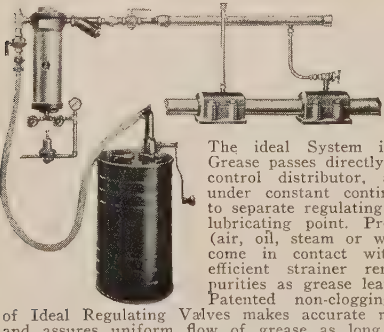

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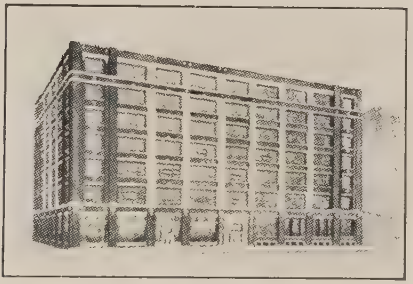

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Summer Meeting

ILLINOIS MINING INSTITUTE
JUNE 7-8-9, 1935

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